New York State College of Agriculture and Life Sciences

Introduction

Programs in agriculture and life sciences offered at Cornell lead to the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy, as well as several professional degrees, including the Master of Professional Studies, the Doctor of Education, and the Master of Arts in Teaching.

Descriptions of courses, both undergraduate and graduate, are given by department. Information about academic programs, admissions, financial aid, placement, and career opportunities may be found in the *Announcement of Academic Information.*

Graduate study is organized under graduate fields, which generally coincide with the departments. Graduate degree requirements are described in the *Announcement of the Graduate School.* Courses for graduate students are described in the section on the academic department that offers them.

Nondepartmental Courses

ALS 5 Basic Review Mathematics Fall or spring. 3 credits (this credit is not counted toward the 120 hours required for the degree). Primarily for entering students.
Fall: M W F 8 (two sections) or 12:20 (two sections). Spring: M W F 12:20 (two sections). H. A. Geiselmann.
Exposes students to some of the concepts necessary for success in other mathematics and science courses. Basic concepts of algebra, analytic geometry, and trigonometry are covered. Considerable emphasis is placed on the analysis and reasoning involved in the solution of verbal problems requiring the use of mathematics.

ALS 27 Introduction to Farm Techniques Fall or spring. Noncredit. Grade does not appear on transcript. For permission to register, contact the Office of Career Planning and Placement, 16 Roberts Hall.
Fall: T or W 2–5. Spring: M T W R or F 2–5. Classes meet at various college farm facilities. W. F. Miller.
Provides supervised instruction in the basic manual skills of farming, including milking by hand and machine, handling livestock, and operating tractors and field equipment. General orientation to the practices and procedures of day-to-day farm operation.

ALS 115 Introductory College Mathematics Fall or spring. 4 credits.
M W F 8, 9:05, or 12:20 (two sections); lab, T 11:15 or 12:20, or R 11:15 or 12:20. H. A. Geiselmann.
Designed to give students with sound high school mathematics backgrounds a unified treatment of the basic concepts of college algebra, analytic geometry, and the elements of calculus. Considerable emphasis is placed on the concept of function, graphing, problem solving, and methods of proof. The Cornell University Computing Language (PL/C) is taught and used to strengthen and integrate the mathematical topics covered.

ALS 401—402 America and World Community (also Government 401–402) 401, fall; 402, spring. 3 credits each term.
M W 7:30 p.m. One World Room, Anabel Taylor. N. E. Awa, R. A. Baer, H. Feidman, J. C. Mbata, R. J. McNeil, K. L. Robinson, and other professors to be announced.
The theme of world community is examined in terms of the directions that the concept suggests, with special reference to the role of the United States in translating the concept to reality. The course seeks to examine the American experience against the background of world community from the points of view of the humanities, the social sciences, the natural sciences, and religious studies.

ALS 416 Agriculture, Society and the Environment Spring. 3 credits.
Lecs, T R 12:20; disc W evenings and by arrangement. D Pimentel and others to be announced.
This course, designed and conducted by Cornell students and staff, is aimed at interrelating the many facets of agriculture. The course stresses the importance of a holistic approach to agriculture by offering perspectives on many factors related to food production: soil fertility, plant breeding, pest control, ecosystems, world food problems, livestock production, energy, economics, social and political concerns, labor problems, and land and water management. This approach is used to develop the basic framework on which future options and strategies for food production in the United States and the world are examined and evaluated.

ALS 695 Environmental Biology Fall and spring. 1–3 credits. Prerequisite: permission of instructor.
Hours to be arranged D. Pimentel.
Focuses on complex energy-environmental problems, using a multidisciplinary approach. Task forces of nine students, each group representing several disciplines, investigate significant energy-environmental problems. Each task force spends two semesters preparing a report for publication, modeled after National Academy of Sciences reports.

Agricultural Economics

O. D. Forker, chairman; D. J. Allee, B. L. Anderson, R. D. Aplin, R. Barker, P. Barkley, S. L. Barraclough, N. L. Bills, D. Blandford, R. N. Boisvert, M. E. Brunk, J. B. Bugliari, D. L. Call, G. L. Casler, L. D. Chapman, H. E. Conklin, G. J. Conneman, J. Conrad, L. M. Day, D. K. Freebairn, G. A. German, D. C. Goodrich, Jr., L. L. Hall, R. B. How, R. J. Kalter, W. A. Knoblauch, E. L. LaDue, W. H. Lesser, J. F. Metz, Jr., R. A. Milligan, T. D. Mount, A. M. Novakovic, T. T. Poleman, K. L. Robinson, D. G. Sisler, R. S. Smith, B. F. Stanton, R. P. Story, J. A. Sweeney, L. Tauer, W. G. Tomek, G. B. White

150 Economics of Agricultural Geography Fall. 3 credits.
Lecs, M W F 11:15 or 12:20. Prelims, R 7 p.m. Sept. 29 and Oct. 27. D. G. Sisler.
The economics and geography of world agriculture, providing a basis for understanding past development and future changes. Elementary economic principles, historical development, physical geography, and population growth are studied in their relation to agricultural development and the economic problems of farmers. Where possible, current domestic and foreign agricultural issues are used to illustrate principles.

220 Introduction to Business Management Fall. 3 credits.
Lecs, M W F 10:10. disc, M 12:20–2:15 or 2:30–4:25; T 8–9:55, 10:10–12:05, 12:20–2:15, or 2.30–4:25; W 8–9:55, 10:10–12:05, 12:20–2:15, or 2:30–4:25. In weeks when discussions are held, there will be no W lecture. Discussions will be held instead of a lecture in all but four weeks of the term. R. D. Aplin.
Principles and tools useful in performing four major functions of management: planning, organizing, directing and leading, and controlling. Within this framework, consideration is given to social, legal, and economic environments; forms of business ownership; financial statements; cost behavior; and a few key concepts and tools in financial management.

221 Accounting Spring. 3 credits. Not open to freshmen.
Lecs, M F 10:10; lab, T W or R 8–9:55, 10:10–12:05, 12:20–2:15, or 2:30–4:25; two evening prelims. J. Sweeney.
A comprehensive introduction to financial accounting concepts and techniques, intended to provide a basic understanding of the accounting cycle and the elements of financial statement analysis and interpretation. Concepts rather than procedures are emphasized.

240 Marketing Spring. 3 credits.
Lecs, M W F 11:15, lab, M 2:30–4:25. T 12:20–2:15 or 2:30–4:25, W 2:30–4:25, R 12:20–2:15 or 2:30–4:25, or F 10:10–12:05. In weeks labs are held, there will be no F lecture. D. C. Goodrich.
An introductory study of the food marketing system and the society it serves, including the goals and practices of farmers and marketers (in such areas as buying and selling, grading, transporting, packaging, and advertising), price-making institutions (such as commodity futures markets), the behavior and purchasing practices of consumers, and the interrelationships among these groups.

250 Introduction to Energy Resources Spring. 3 credits.
Lecs, M W F 11:15. D. Chapman.
An introduction to the concepts of efficiency, competitive equilibrium, and social cost. The course focuses on basic energy resources, examining production costs and demand for petroleum, natural gas, electricity, nuclear power, and solar energy. The ownership and regulatory structure of each energy industry is discussed, as well as selected policy issues such as price control, taxation, public ownership, conservation, and renewable resource use.

302 Farm Business Management Spring. 4 credits. Not open to freshmen. This course is a prerequisite for Agricultural Economics 402.
Lecs, M W 10:10; disc, F 8, 9:05, 10:10, 11:15, or 12:20; lab, T W or R 1:25–4:25. On days farms are visited, the laboratory period is 1:25–5:30. One all-day trip and four half-day trips are taken to visit farm businesses. G. J. Conneman.
An intensive study of problems associated with planning, organizing, operating, and managing a farm business, with emphasis on the tools of managerial analysis and decision making. Topics include management information systems, business analysis, economic principles, and budgeting; and acquisition, organization, and management of capital, labor, land, and machinery.

310 Introductory Statistics Fall. 3 credits. Prerequisite: ALS 115 or equivalent level of algebra.
Lecs, M W F 12:20; lab, M 2:30 or 3:35, T 2:30 or 3:35, or W 2:30 or 3:35. D. Blandford.
An introduction to statistical inference including probability concepts, estimation, hypothesis testing, and linear regression.

320 Business Law Fall. 3 credits. Limited to upperclass students.
Lecs, M W F 9:05; one evening prelim. J. B. Bugliari.
Consideration is given chiefly to legal problems of particular interest to persons who expect to engage in business. Emphasis is on personal property, contracts, agency, real property, and partnerships and corporations.

321 Business Law Fall. 4 credits. Limited to upperclass students. Prerequisite: permission of instructor.
Lecs, M W F 9:05; disc, M 4; one evening prelim. J. B. Bugliari.
The lecture portion is the same as Agricultural Economics 320. Discussions deal with practical applications of the legal principles covered in that course and attempt also to give some deeper insight into the roles and functions of the lawyer and the judiciary in our society.

322 Taxation in Business and Personal Decision Making Spring. 3 credits. Recommended: background in accounting and business law.
Lecs, M W 2:30–4. J. B. Bugliari, R. S. Smith.
The impact of taxation, both state and federal, on business and personal decision making. After a brief discussion of tax policy and state and local taxes an in-depth examination is conducted of federal income and estate and gift taxes affecting individuals and business entities. Both tax management and tax reporting are stressed.

323 Managerial Accounting and Economics Fall. 3 credits. Prerequisites: Agricultural Economics 221 and Economics 102 or equivalents.
Lecs, M W 1:25; disc, R 10:10–12:05, 12:20–2:15, or 2:30–4:25 or F 10:10–12:05, 12:20–2:15, or 1:25–3:20; two evening prelims. J. Sweeney.
An introduction to cost accounting that emphasizes the application of accounting and economic concepts to managerial control and decision making. Major topics include basic costing, standard costing, cost behavior, cost allocation, pricing, budgeting, linear programming, inventory control, transfer pricing, and measuring divisional performance.

324 Financial Management Spring. 3 credits. Prerequisites: Agricultural Economics 220 and Economics 102 or equivalents. Recommended: Agricultural Economics 221 or equivalent.
Lecs, M W F 9:05; disc, W 12:20–2:15 or 2:30–4:25, R 8–9:55 or 12:20–2:15, or F 9:05–11 or 12:20–2:15; two evening prelims. In weeks when discussions are held, there will be no F lecture. Discussions will be held instead of lecture in all but two weeks of the term. B. L. Anderson.
Designed to provide knowledge and understanding of business finance. Major topics include capital investment decisions; techniques for handling risk, uncertainty, and inflation in decision making; sources and forms of financing; financial structure; cost of capital; working capital management; and special problems of financial management in the small firm.

332 Economics of the Public Sector Fall. 3 credits. Prerequisite: Economics 102 or equivalent.
Lecs, M W F 11:15; disc, W 2:30–4 or 7:30–9 p.m., R 12:20–1:50, or F 12:20–1:50. P. W. Barkley.
The application of economic concepts to evaluation of the structure and performance of the public sectors of the economy. Emphasis on microeconomic analysis of public finance and public resource allocation. Principal topics: market failure, articulation of public choice and interests,evaluation of public decisions, and current public policy.

340 Economics of Marketing Spring. 3 credits. Prerequisites: Economics 101–102 and Agricultural Economics 240 recommended.
Lecs, M W F 12:20–1:10. L. L. Hall.
This course provides an integrative framework for analysis of marketing functions, activities, and decisions in the food industry. Producer, consumer, and government behavior in the marketing system are explored, and their interaction is discussed. The course focuses on the importance of demand, the industrial organization of the food industry, and the causes and consequences of government intervention.

342 Marketing Management Fall. 3 credits. Prerequisites: Agricultural Economics 240 and Economics 101–102.
Lecs, M W F 10:10; disc, R 2:30 or F 10:10, 11:15, or 12:20. In weeks discussions are held, there will be no F lecture. D.C. Goodrich.
Deals with principles and practices in the management of the marketing function. Emphasizes the revenue aspects of marketing by considering sales forecasting and strategies of the firm in product and brand selection, pricing, packaging, promotion, and channel selection. Identification and generation of economic data necessary for marketing decisions are considered.

[346 Pricing Milk and Dairy Products Fall. 3 credits. Not offered 1980–81.
Lecs, M W F 11:15; disc, F 12:20.
A review of the structural characteristics of the dairy industry and an analysis of the pricing systems for market milk. Particular attention is given to government programs, including marketing orders, price supports, and import policies.]

347 Marketing Horticultural Products Fall. 3 credits. Prerequisite: Agricultural Economics 240 or equivalent.
T R 8–9:55. All-day field trip the last Saturday in September. R.B. How.
A study of markets, marketing channels, and marketing services for fruits, vegetables, and floricultural commodities. An evaluation of marketing alternatives facing growers, shippers, wholesalers, and retailers of horticultural products. The role of public agencies in market information and regulation. The potential for group action to improve marketing operations.

350 Resource Economics Fall. 3 credits. Prerequisite: either Natural Resources 201 and introductory economics or permission of instructor.
Lecs, T R 10:10; disc, T 1:25–3:20 and as arranged. D. J. Allee, H. E. Conklin.
The application of economic and political science concepts to the use of natural resources, with varying attention to water, land, forests, and fisheries. Considers regional growth, the impact of urban growth, and public decision making in the resources and environmental management area.

351 Farm and Food Policies Fall. 3 credits. S-U grades optional.
Lecs, T R 9:05; disc, R 11:15 or 1:25 or F 10:10. K. L. Robinson.
The course deals broadly with farm and food policies, including price support and storage or reserve policies, international food aid, agricultural protection, the structure of agriculture, and domestic food subsidy programs.

352 Agricultural Prices Spring. 3 credits. Recommended: background in economics, such as Economics 101–102
M W F 11:15. K. L. Robinson.
An analysis of supply and demand characteristics of farm commodities, institutional aspects of pricing farm and food products, temporal and spatial price relationships, price forecasting, and the economic consequences of pricing decisions.

380 Independent Honors Research in Social Science Fall or spring. 1–6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.

402 Advanced Farm Business Management Spring. 3 credits. Prerequisite: Agricultural Economics 302 or equivalent.
Lecs, M W 9:05; disc, W R 1:25–3:20. G. L. Casler.
Emphasis is on evaluating the profitability of alternative investments and enterprises. Principal topics include the affects of income taxes on investment decisions, capital investment analysis, linear programming, and financial risk and uncertainty. Experience in computer applications to farm business management is provided.

405 Farm Finance Fall. 3 credits. Prerequisite: Agricultural Economics 302.
Lecs, T R 11:15; disc, W 1:25–3:20. E. L. LaDue.
The principles and practices used in financing farm businesses, from the perspectives of the farmer and the farm lender. Topics covered include sources of capital, financing entry into agriculture, financial analysis of a business, capital management, financial statements, credit instruments, financial risk, and the forms of business organizations.

406 Farm and Rural Real Estate Appraisal Fall. 4 credits. Limited to 45 students. Prerequisites: Agricultural Economics 302 or equivalent *and* permission of instructor.
Lecs, T R 10:10; lab, R 1:25–4:25. On days farms are visited the laboratory period is 1:25–5:30. One all-day trip, G. J. Conneman.
The basic concepts and principles involved in appraisal. Factors governing the price of farms and rural real estate and methods of valuation are studied. Practice in appraising farms and other rural properties.

407 Advanced Agricultural Finance Seminar Spring. 2 credits. Limited to 16 seniors with extensive course work in farm management and farm finance. Open by application prior to March 1 of the year before the course is offered.
T 3:35–5:30. E. L. LaDue.
A special program in agricultural finance conducted with financial support from the Farm Credit System. Includes two days at Farm Credit Banks of Springfield, one week in Farm Credit Association offices, an all-day field trip observing FHA financing during fall term, a four-day trip to financial institutions in New York City during intersession, and lecture-discussions in the spring term. Representatives from banking, agribusiness, finance, and similar areas participate in spring term lecture-discussion sessions.

409 Farm Management Seminar Fall. 1 credit. Limited to seniors and graduate students.
M 1:25–3. B. F. Stanton and staff.
Presentation and interpretation of research in farm management and production economics. Each participant conducts a seminar and prepares a publishable evaluation of research results directed toward farmers and extension and business leaders.

412 Introduction to Linear Programming Spring. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: Agricultural Economics 310 or equivalent.
Lecs, M W 10:10; lab, W 1:25–3:20 or 3:35–5:20. B. F. Stanton
An introduction to the concepts and computational procedures of linear programming. Emphasis on interpretation of results, model building, and data requirements for estimation using standard computer programs. Topics include sensitivity analysis, parametric programming, the transportation problem, scheduling, and distribution. Primary applications are made to agriculture and business.

420 Advanced Business Law Spring. 3 credits. Limited to upperclass students.
Lecs, T R 8:30–9:55; one evening prelim. J. B. Bugliari.
Designed to provide a fairly detailed and comprehensive legal background. Selected areas covered in Agricultural Economics 320 are further developed, and particular consideration is given to the law pertaining to bailments, sales, secured transactions, bankruptcy, negotiable instruments, and, if time permits, insurance.

421 Advanced Business Law Spring. 4 credits. Limited to upperclass students. Prerequisite: permission of instructor.
Lecs, T R 8:30–9:55; disc, T 4; one evening prelim. J. B. Bugliari.
Lectures cover the same material as Agricultural Economics 420. The discussions cover aspects of estate planning: estate planning techniques, the law and use of trusts, the law of wills, and federal and New York State estate and gift taxes and probate procedures.

424 Business Policy Spring. 3 credits. Limited to seniors majoring in business management and marketing.
T R 9:30–11 or 11:15–12:45. R. D. Aplin.
An integrating course that examines business policy formulation and execution from the standpoint of the general manager of an organization, focusing on decision making at the top management level. The course is built around a series of cases. Emphasizes improving oral and written communication skills.

425 Personal Financial Management Spring. 2 credits. Primarily for seniors.
Lec, M 12:20–2:15; disc to be arranged. Second hour of lecture will be omitted in weeks when discussions are held. Staff.
Managing personal income to maximize financial goals and objectives. Discussions are devoted to problems and case studies in financial planning for students and young families. Discussion leaders include representatives of financial institutions, such as banks and insurance companies.

426 Management of Cooperative Action Fall. 3 credits.
Lecs, M W F 9:05; disc to be arranged.
B. L. Anderson.
Investigates the economic role, function, and impact of various forms of group action in agriculture. Institutions considered range from informal interest groups to marketing boards. Attention is given to the theory and operation of cooperative organizations. Topics covered include organization, decision making, structure, methods of financing, legal status, tax treatment, and market performance.

430 Agricultural Trade Policy Fall. 3 credits. Primarily for seniors and M.S. degree candidates. Prerequisites: Agricultural Economics 351 and either Agricultural Economics 352 or Economics 311.
Lecs, T R 11:15; lec or disc, W 3:35. D. Blandford.
An examination of the rationale and method of commodity trade policy. The course analyzes problems and issues in both developed and less-developed countries and deals with the major questions associated with the organization of international commodity markets.

443 Food Industry Management Spring. 4 credits. Limited to juniors and seniors.
M W F 10:10, W 2–4. G. A. German.
A case-study approach is used to examine the application of management principles and concepts to operating problems of food retailers and wholesalers. Areas included are site selection, buying, merchandising, personnel administration, private label products, and financing expansion programs. Leading food industry specialists frequently join the W session.

448 Food Merchandising Fall. 3 credits. Limited to juniors and seniors. Prerequisite: Agricultural Economics 240.
Lecs, T R 10:10–11:25. G. A. German.
Merchandising principles and practices as they apply to food industry situations. The various elements of merchandising are examined, including buying, pricing, advertising, promotion, display, store layout, profit planning and control, and merchandising strategy.

449 Field Study of Marketing Institutions Fall. 2 credits. Prerequisites: course work in marketing or business management and permission of instructor. Field trips will cost approximately $150.
W 3:30–4:30. Two one-day field trips to the upstate area and a three-day trip to the New York City area during intersession just before spring registration. W. J. Lesser, B. L. Anderson.
Opportunity for upper-level students to integrate their classwork through a close examination of the marketing institutions, operations, and price determination methods for a cross section of agricultural products.

450 Evaluating Resource Investment and Environmental Quality Spring. 3 credits. Primarily for juniors and seniors. Prerequisite: an introductory course in economics, a 300-level agricultural economics course, or permission of instructor.
T R 10:10–11:30; disc to be arranged. D. J. Allee.
Means of reaching decisions on environmental questions. Concepts of social value and cost-benefit analysis, determination of degrees of importance of environmental problems, environmental impact statements, definitions of environmental quality, and questions of political economy.

452 Agricultural Land Policy Spring. 3 credits.
Lec, F 8–9:55; disc, F 1:25–3:25; field trips to be arranged. H. E. Conklin.
Recent changes in the laws, programs, and policies at state and local levels that affect the use of farmland in the northeastern United States.

464 Economics of Agricultural Development Spring. 4 credits. Prerequisites: Agricultural Economics 150 and Economics 101–102, or permission of instructor.
T R 9:05 and T or W 1:25. D. K. Freebairn.
An examination of the processes of agricultural development in Third World nations and their interactions with United States policy. Agricultural and rural development policy, the interdependence of agriculture with other sectors, alternative forms of agricultural organization, and policies tending to alleviate highly concentrated income distributions are all emphasized.

499 Undergraduate Research Fall or spring. 1–4 credits. Limited to seniors with grade point averages of at least 2.7.
Prerequisite: written permission of the staff member who will supervise the work and assign the grade; this permission must be attached to course enrollment material. S-U grades optional.

Permits outstanding undergraduates to carry out independent study of suitable problems under appropriate supervision.

540 Marketing Research Spring. 2 credits. Prerequisite: permission of instructor.
Lec, R 12:20–2:15. M. E. Brunk.
Objectives of marketing research, organization and management of research and research agencies, problem identification, selecting and planning projects, and design and use of research by management.

608 Production Economics Fall. 3 credits. Prerequisite: Economics 311 or equivalent. Recommended: Mathematics 108 or 111 or equivalent.
Lecs, M W F 12:20. G. B. White.
A comprehensive survey of the theory of production economics with emphasis on applications to agriculture and agribusiness. Topics include the derivation, estimation, and use of production, cost, and supply functions.

650 Economic Analysis of Public Policy Spring. 4 credits. Primarily for graduate students but open to seniors.
Prerequisite: Economics 311 or 511, or permission of instructor.
T R 9:05–11. R. J. Kalter.
The application of economic theory and analysis to governmental decision-making, budgeting, and expenditure processes with emphasis on the welfare criteria of economic efficiency and income distribution. Techniques of benefit-cost, equity, and environmental analysis will be stressed. Discount rates, benefit estimation, externalities, multipliers, uncertainty and social welfare functions will be covered.

651 Economic Aspects of Energy Use Fall. 4 credits. Offered even-numbered years.
Lec-sem F 1:15–4:15. D. Chapman.
Selected subjects in economic research, including the macroeconomic study of income, employment, and energy use; energy-labor substitutability; decentralized technologies; taxation of utilities and petroleum companies; nuclear economics; competition and monopoly; and public policy.

652 Special Problems in Land Economics Fall or spring. 1 or more credits. Limited to graduate students. Prerequisite: permission of instructor.
Hours to be arranged. D. J. Allee, H. E. Conklin.
Special work on any subject in the field of land economics.

660 Food, Population, and Employment Fall. 5 credits. Enrollment limited to 15 to ensure that students have an opportunity to work individually with instructor.
M W 2:30–4 and an individual weekly meeting with the instructor. T. T. Poleman.
Examines the links between employment, food, and population growth in less-developed countries. Food economics and the world food situation are treated as cornerstones and examined in historical perspective. Requires a major term paper.

661 Food, Population, and Employment II Spring. 1–3 credits. Prerequisite: permission of instructor.
Individual weekly meeting with the instructor. T. T. Poleman.
Individual, guided research for students who want to carry on with projects initiated in Agricultural Economics 660 or to undertake new ones.

664 Microeconomic Issues in Agricultural Development Spring. 3 credits. Prerequisite: Agricultural Economics 608, Economics 311, or permission of instructor.
T R 11–12:30. R. Barker.
Issues such as production efficiency, induced technological change, allocation of research resources, and the distribution of benefits from new technology are discussed. The theoretical argument is related to applied research problems.

665 Seminar on Latin American Agricultural Policy Fall. 3 credits. Prerequisite: Agricultural Economics 464 or permission of instructor.
T 2:30–4:25. D. K. Freebairn.
An examination of policies for the development of the agricultural sector in Latin America, including an identification of policy objectives and a review of the instruments of public policy implementation. Particular attention is paid to the interactions of agrarian structure, agricultural productivity, and rural welfare.

666 Seminar in Agricultural Development Fall or spring. 3 credits. The seminar is normally taught when a visiting professor is available who has had recent direct experience in low-income countries.
Hours to be arranged.
An analysis of current problems for the development of the agricultural sector of low-income countries, with emphasis on the implications of such problems to the definition of research.

699 M.P.S. Research 1–6 credits. Prerequisite: registration as an M.P.S. student. Credit is granted for the M.P.S. project report.

700—701 Special Topics in Agricultural Economics Fall or spring. Credit to be arranged. Limited to graduate students.
Hours to be arranged. Staff.
A group discussion of areas of special interest in the field of agricultural economics. Students are required to review literature and present oral or written reports or both.

708 Advanced Production Economics Fall. 3 credits. Prerequisites: Agricultural Economics 608, 710, or equivalents.
Hours to be arranged. R. N. Boisvert.
Theoretical and mathematical developments in production economics, with emphasis on estimating microproduction and macroproduction relationships, scale economies, technical change, factor substitution, recently developed functional forms, statistical estimation and hypothesis testing. Discussion of topics such as risk, supply response, household production functions, etc., will be determined by student interest.

710 Econometrics I Spring. 4 credits. Not open to undergraduates. Prerequisites: Statistics 416 and 601 or equivalent.
Lecs, T R 2:30–4:25. W. G. Tomek.
A comprehensive treatment of the classical linear regression model at the level of *Econometric Methods,* by Johnston. Generalized least squares, analysis of covariance, and elementary distributed lag models are introduced. Simultaneous equations estimators constitute about 30 percent of the course. Principles of econometrics are emphasized as a basis for empirical research.

711 Econometrics II Fall. 4 credits. Prerequisite: Agricultural Economics 710 or equivalent. Statistics 417 recommended.
Lecs, T R 2:30–4:25. T. D. Mount.
Coverage beyond that of Agricultural Economics 710 of generalized least squares, models with stochastic regressors, testing linear hypotheses, and the effects of specification errors. Applications include seemingly unrelated regressions, three-stage least squares, estimation with pooled data, models with stochastic coefficients, and distributed lag models. Other topics covered are principal components, factor analysis, and probit and logit analysis, with extensions to deal with multinomial problems.

712 Quantitative Methods I Fall. 4 credits. Prerequisite: Statistics 416 or equivalent. Statistics 417 suggested.
Lecs, M W F 11:15. R. N. Bosivert.
A comprehensive treatment of linear programming and its extensions, including postoptimality analysis and the transportation model. Special topics in integer and nonlinear programming, including spatial equilibrium and risk programming models. Input-output models are treated in detail. Applications are made to problems in agricultural, resource, and regional economic problems.

713 Quantitative Methods II Spring. 4 credits. Prerequisite: Agricultural Economics 712 or permission of instructor.
Lecs, M W F 9:05–9:55; disc, F 1:25–3.
R. A. Milligan.
A study of quantitative techniques used to solve dynamic problems. The first half of the course is concerned with simulation; the second, with dynamic optimization.

714 Econometric Models Spring. 3 credits. Offered alternate years.
Lec to be arranged. T. D. Mount, W. G. Tomek.
The theory and art of specifying and evaluating econometric models. Topics include economic theory as a guide to model building, evaluating parameter estimates, sequential estimators, and evaluating the forecasting ability of a model. Empirical studies in agricultural economics provide a basis for discussion.

717 Research Methods in Agricultural Economics Spring. 2 credits. Limited to graduate students.
M 1:25–3:20, B. F. Stanton and D. G. Sisler.
Discussion of the research process and scientific method as applied in agricultural economics. Topics include problem identification, hypotheses, sources of data, sampling concepts and designs, methods of collecting data, questionnaire design and testing, field organization, analysis of data, and development of research proposals.

730 Seminar on Agricultural Trade Policy Spring. 3 credits. Limited to graduate students. Prerequisites: Agricultural Economics 430 and basic familiarity with quantitative methods. Offered alternate years.
F 1:25–4. D. Blandford, D. G. Sisler.
A discussion of selected topics in agricultural trade policy, such as export promotion versus import substitution in developing countries, and the role of international commodity agreements. The preparation of a term paper is an important part of the course.

[731 Seminar on Methods of Trade and Commodity Policy Analysis Spring. 3 credits. Limited to graduate students. Prerequisites: basic training in quantitative methods (Agricultural Economics 710 and 712 or equivalent) and permission of instructor. Offered alternate years. Not offered 1980–81.
F 1:25–4. D. Blandford.
A discussion of the structure, use, and usefulness of alternative quantitative methods of commodity policy analysis. Preparing a term paper is an important part of the course.]

741 Agricultural Markets and Prices Fall. 3 credits. Registration by permission of instructor. Recommended: Agricultural Economics 710 and advanced microeconomic theory.
T R 12:20–2:15. Staff.
Economic theory and analytic methodology are discussed as they apply to the analysis of agricultural marketing and pricing problems and policies. Relevant supply, demand, and trade theories and multiproduct, spatial, and temporal models are studied. The emphasis is on the use of economic theory and empirical models to analyze agricultural policies and problems.

742 Agricultural Markets and Public Policy Spring. 3 credits. Limited to graduate students. Prerequisite: familiarity with multiple regression techniques on the level of Statistics and Biometry 601.
T R 12:20–2:15. W. H. Lesser.
Develops the concepts and methodology for applying and analyzing the effects of public policy directives on the improvement of performance in the United States food marketing system. Topics include a survey of industrial organization principles, antitrust and other legal controls, coordination systems in agriculture and cooperative theory and performance. An application of these techniques to analyzing marketing problems in developing economies is also presented.

743 Export Marketing Fall. 3 credits. Limited to graduate students. Estimated cost of field trip, $60.
Lec, R 2:30–4:25. Overnight field trip to New York City required. M. E. Brunk.
The history and development of commercial United States exports of agricultural commodities and the mechanics and procedures of exporting. Alternatives in sales contracts, shipping, insurance, financing, business structure, researching markets, and promotion. Trading experiences of specific commodity specialists.

751 Seminar on Agricultural Policy Spring. 2 credits. Limited to graduate students. Offered alternate years.
W 1:25–3:20. K. L. Robinson.
A review of the professional literature relating to agricultural policy issues, and techniques appropriate to the analysis of such issues.

752 Readings in Philosophy Spring. 3 credits. Limited to Ph.D. degree candidates.
S 9:05–12. H. E. Conklin.
Readings, selected for their relevance to research in agricultural economics, are chosen from among books such as *Structure of Scientific Revolutions, The Theory of Experimental Inference, The Nerves of Government, Economics as a Science,* and *A Theory of Economic History.*

Related Courses in Other Departments

Statistics II (I&LR 311)

Introduction to Computer Uses in Data Analysis (Agricultural Engineering 304)

Matrix Algebra I (Statistics and Biometry 416)

Matrix Algebra II (Statistics and Biometry 417)

Agricultural Engineering

N. R. Scott, chairman; L. D. Albright, J. A. Bartsch, R. D. Black, J. K. Campbell, J. R. Cooke, R. B. Furry, R. W. Guest, W. W. Gunkel, D. A. Haith, W. W. Irish, L. H. Inwin, W. J. Jewell, F. G. Lechner, G. Levine, R. C. Loehr, H. A. Longhouse, R. T. Lorenzen, D. C. Ludington, E. D. Markwardt, W. F. Millier, R. A. Parsons, R. E. Pitt, D. R. Price, G. E. Rehkugler, J. W. Spencer, T. S. Steenhuis, L. P. Walker, M. F. Walter

101 Mechanical Drawing Fall. 3 credits.
Lecs, T R 8; lab, W 1:25–4:25. H. A. Longhouse.
Introduction to mechanical drawing including lettering, sketching, multiview drawings, sections, auxiliaries, revolutions, pictorial drawings, elementary descriptive geometry, and the application of these principles to problems. Both machine and architectural drawing conventions are discussed. Introduction to computer graphics is included.

110 Farm Metal Work Fall or spring. 2 credits.
Lec, R 9:05; fall labs, M or T 1:25–4:25; spring labs, M T or R 1:25–4:25. F. G. Lechner.
M lab, limited to 24 students, includes instruction in the fundamentals of metal lathe work and arc and oxyacetylene welding. T and R labs, each limited to 20 students, include instruction in sheet metal work, pipe fitting, hot and cold metal work, and arc and acetylene welding.

131 Elements of House Design Spring. 3 credits. Prerequisite: high school or college physics. S-U grades optional.
Lecs, T R 10:10; lab, T W or R 1:25–4:25.
L. D. Albright.
An introduction to the design process. The basic principles of planning and design of buildings and systems for human habitation, with emphasis on the rural dwelling. Topics include site selection, structural design, water and waste water systems, electrical systems, lighting, heating, solar systems, ventilation, and air conditioning.

132 Farm Carpentry Fall. 2 credits. Each lab limited to 15 students.
Lec, T 9:05; labs, T W or R 1:25–4:25.
F. G. Lechner.
Instruction in the fundamentals of farm carpentry, including concrete work, and equipment and buildings constructed of wood. Each student is required to plan and construct an approved carpentry project.

151 Introduction to Agricultural Engineering and Computing Fall. 2 or 3 credits. Prerequisite: one term of calculus or concurrent registration in a calculus course.
Lecs, T F 1:25–2:15; rec-labs, T F 2:30–4:25. R. B. Furry.
An introduction to digital computing with the PL/C and WATFIV languages through the use of computing problems in agricultural engineering subjects and related areas such as environmental technology and agriculture. Basics of PL/C and WATFIV are completed in 10 weeks for 2 credits. The remainder of the course introduces interactive computing and requires the completion of a comprehensive computing problem.

152 Engineering Drawing Spring. 3 credits. Limited to 72 students (36 in each lab).
Lecs, M W 8; lab, M or T 1:25–4:25. H. A. Longhouse.
Designed to promote an understanding of the engineer's universal graphic language. The lectures and laboratories develop working knowledge of drawing conventions, drafting techniques, and their application to machine and pictorial drawing problems. Introduction to descriptive geometry and computer graphics is also included.

200 Undergraduate Seminar Spring. 1 credit.
Lec, M 2:30. N. R. Scott.
A forum to discuss the contemporary and future role of agricultural engineering in society. A series of lectures will be given by practicing agricultural engineers, Cornell faculty members, and students. Written critiques are required. Students may take the seminar more than once but are limited to 2 credits maximum.

201 Energy and Man Spring. 3 credits. Prerequisite: high school or college physics.
Lec, M W F 10:10. D. R. Price.
Basic concepts of energy and traditional and alternate sources of energy. The energy transfer process is investigated. Topics include heating, cooling, drying, solar radiation, electricity, refrigeration, wind power, geothermal energy, biogas production, and energy economics and policy.

208 Application of Physical Sciences I Fall. 3 credits. Prerequisite: a term of calculus and high school physics or a year of college physics.
Lecs, T R 8–9:55; rec, F 8, 9:05, or 10:10. D. C. Ludington.
The application of statics, dynamics, mechanics of materials, and fluid mechanics to physical problems in agriculture. Topics include torque, free-body diagrams, friction, energy, stress, bending, shear, fluid flow, and wall pressures. Emphasis is on problem solving.

209 Application of Physical Sciences II Spring. 3 credits. Prerequisite: Agricultural Engineering 208.
Lecs, T R 8:20–9:55; rec, F 8, 9:05, or 10:00. D. C. Ludington.
A continuation of Agricultural Engineering 208. The laws of thermodynamics and principles of energy transfer, psychrometrics, and electricity are covered. Topics include applications in agriculture of the various gas and vapor cycles used in engines and refrigeration, heat conduction through multiple layers, convection, solar radiation, lighting principles, behavior of air and water vapor mixtures, and basic electricity. Solving practical problems is emphasized.

221 Plane Surveying Fall. 3 credits. Limited to 90 students (30 per lab). S-U grades optional.
Lecs, T R 11:15; lab, M T or W 1:25–4:25. Staff.
An introduction to plane surveying. The use and care of equipment is stressed during field problems related to construction and mapping.

250 Engineering Applications in Biological Systems Spring. 3 credits. Prerequisite: coregistration in Mathematics 294, Engineering M&AE 221, and Engineering T&AM 202.
Lec, M W F 12:20. R. E. Pitt.
Case studies of engineering problems in agricultural and biological systems including animal and crop production, environmental control, energy, and food engineering. Emphasis will be on the application of mathematics, physics, the engineering sciences, and biology to energy and mass balances in agricultural systems.

301 Safety and Accident Prevention Spring. 2 credits. S-U grades optional.
Lecs, T R 9:05. Staff.
Educational programs, engineering design, and legal efforts including the federal Occupational Safety and Health Act will be studied. Safety-related organizations ranging from local police and fire departments to international organizations such as National Fire Protection Association and the United Nations are reviewed. Emphasis is on agricultural and rural applications.

304 Introduction to Computer Uses in Data Analysis Spring. 3 credits. Each lab limited to 36 students. Prerequisite: one course in college mathematics or statistics or permission of instructor. S-U grades optional.
T R 11:15; lab, M T W R or F 1:25–2:15. R. B. Furry.
An introductory course in computing for those interested in using digital computers to handle data. Topics include description and preparation of data, preparing and processing computer programs, computer attributes and applications, computer library programs, and related computing facilities. No prior knowledge of computers or computing languages is necessary.

305 Principles of Navigation Fall. 4 credits.
3 lecs, disc, and project period at hours to be arranged. R. D. Black.
Coordinated systems, chart projections, navigational aids, instruments, compass observations, tides and currents, soundings. Celestial navigation: time, spherical trigonometry, motion of stars and sun, star identification, position fixing, Nautical Almanac. Electronic navigation.

310 Advanced Farm Metal Work Fall or spring. Fall, 1 credit; spring, 1 or 2 credits. Prerequisite: permission of instructor.
Lab, F 1:25–4; for 2 credits a second lab must be arranged. F. G. Lechner.
Fall: advanced machine shop. Spring: advanced welding and metal construction project.

311 Farm Machinery Fall. 3 credits. Not open to freshmen. Each lab limited to 16 students. Prerequisite: high school physics or equivalent.
Lec, T R 10:10; rec-lab, T W or R 1:25–4:25. W. F. Millier.
A study of the operating principles, use, selection, and methods of estimating costs of owning and operating farm machines. Lab work includes practice in the calibration of planting, fertilizing, and pesticide application machinery and study of the functional characteristics of agricultural machines and machine components.

312 Internal Combustion Engines for Agriculture Spring. 3 credits. Each lab limited to 16 students. Prerequisite: high school physics or equivalent.
Lec, T R 11:15; lab, M T W or R 1:25–4:25. W. F. Millier.
A study of the principles of operation, adjustment, and maintenance of hydrocarbon-fueled single cylinder and multicylinder internal combustion engines. Topics include engine cycles, fuels, lubricants, carburetion, fuel injection systems, ignition, charging circuits, pollution control methods, valve reconditioning, and engine testing.

315 Electricity on the Farm Spring. 3 credits. Prerequisite: Agricultural Engineering 131, Physics 102, or equivalent.
Lec, T R 10:10; lab, T or R 1:25–4:25. D. C. Ludington.
The application of electricity for light, heat, and power on farms, with emphasis on the principles of the operation, selection, and installation of electrical equipment for the farmstead.

321 Soil and Water Conservation Spring. 2 credits. Must be taken with Agronomy 321. S-U grades optional.
Lec, F 8; disc-lab, M or T 1:25–4:25 (additional labs offered if enrollment requires it). R. D. Black.
A study of the principles and practices used in the solution of soil and water conservation problems. Both farm and nonfarm problems are explored. Engineering aspects of erosion control, water management, water storage, and drainage are examined.

325 Introduction to Environmental Pollution Spring. 3 credits. S-U grades optional.
M W F 9:05. Staff.
A general course dealing with impairment of the environment by human wastes. The causes and effects of air, water, and soil pollution are discussed. Fundamental factors underlying waste production, abatement, treatment, and control are included. Wastes from urban, rural, and indistrial areas are used to illustrate the factors.

331 Farmstead Production Systems Fall. 3 credits. S-U grades optional.
M W F 8. R. T. Lorenzen.
A study of layout, material handling, and environment associated with agricultural production on the farmstead. Planning and design techniques pertaining to biointrinsic and integrated systems are emphasized.

332 Farm Buildings Design Fall. 2 credits. Prerequisite: concurrent or previous registration in Agricultural Engineering 331.
Lec-lab, R 1:25–4:25. R. T. Lorenzen.
Structural design of buildings used for farmstead production systems. Wood is emphasized as a structural material. For students with no background in statics or properties of structural materials.

371 Introduction to Hydrology Spring. 2 credits. S-U grades optional.
Lec, R 9:05; lab, T 1:25–4:30. T. S. Steenhuis.
Elements of water and nutrient flow as applied to common problems. Emphasis is on understanding of hydrological cycle, runoff mechanism, and rainfall and runoff probabilities.

401 Career Development in Agricultural Engineering Fall. 1 credit. Limited to seniors. S-U grades optional.
Lec, T 12:20. W. W. Gunkel.
A presentation and discussion of the opportunities and qualifications for and responsibilities of positions of service in the various fields of agricultural engineering.

414 Power Transmission Systems Spring. 2 credits. Limited to 16 students. Prerequisite: Agricultural Engineering 312
Lec, F 12:20; lab, F 1:25–4:25. W. F. Millier.
A study of the principles and operation of hydraulic and mechanical power transmission systems used in agricultural tractors and equipment. Hydraulic power transmission includes system components, circuit diagrams, hydrostatic transmissions, and system analysis. Mechanical power transmission includes clutches, brakes, parallel shaft and planetary transmissions, traction, and drawbar horsepower.

461 Agricultural Machinery Design Fall. 3 credits. Prerequisite: mechanical design or equivalent.
Lec, T R 10:10; lab, F 1:25–4:25. W. W. Gunkel.
The principles of design and development of

agricultural machines to meet functional requirements. Emphasis is given to computer-aided analysis and design, stress analysis, selection of construction materials, and testing procedures. Engineering creativity and agricultural machine systems are also stressed.

462 Agricultural Power Spring. 3 credits. Prerequisite: dynamics and thermodynamics or equivalent.
Lec, T R 10:10; lab, F 1:25–4:25. W. W. Gunkel.
Use of energy in agriculture. Emphasis is given to basic theory and analysis and testing of internal combustion engines and suitable components for use in farm tractors and other power applications. Soil mechanics related to traction and vehicle mobility; economics and human factors in design will be considered.

465 Processing and Handling Systems for Agricultural Materials Fall. 3 credits. Offered alternate years.
Lec, T R 11:15; lab, W 2:30–4:25. R. B. Furry.
Drying, psychrometrics, fluid flow measurement, material handling applications, with an introduction to dimensional analysis and controls for agricultural applications. Problem solutions employ both analog and digital computers.

466 Engineering Design and Analysis of Food Processing Equipment Spring. 3 credits. Prerequisite: Food Science 302, its equivalent, or concurrent enrollment in an engineering curriculum.
T R 9:05, W 1:25–4:25. G. E. Rehkugler.
The analysis and design of food-processing equipment from the point of view of selecting and designing equipment appropriate for transporting or modifying a food product.

471 Soil and Water Engineering Fall. 3 credits. Prerequisite: hydrology and fluids or permission of instructor.
Lec, T R 9:05; lab, R 2:30–4:25. M. F. Walter.
The application of engineering principles to problems of soil and water management. Analysis and design of water management systems including hydraulic structures, channels, small reservoirs, and sediment control.

475 Introduction to Environmental Systems Analysis Fall. 3 credits. Prerequisite: a year of calculus.
M W F 11:15. D. A. Haith.
Introduction to systems analysis and its application to environmental quality management. Simulation, linear programming, and dynamic programming applied to problems in water and air pollution control, solid waste disposal, agricultural wastes, etc.

481 Agricultural Structures Design Spring. 3 credits. Prerequisite: Engineering CEE G301.
Lec, T R 1:25; disc-lab, R 2:30–4:40.
R. T. Lorenzen.
Application of basic structural concepts to design of agricultural structures. Emphasizes wood structures, including design of trusses, rigid frames, prefabricated panels, and columns.

482 Environmental Control for Animals and Plants Spring. 3 credits. Prerequisite: thermodynamics.
Lec, M W 11:15; lab, F 1:25–4:25. L. D. Albright.
Thermal interchanges between animals (including humans) and plants and the environment. Physiological principles affecting thermal comfort and health. Ventilation, thermal modeling, psychrometrics, solar energy, and weather phenomena.

491 Highway Engineering Fall. 3 credits. Prerequisite: Engineering CEED301 or permission of instructor.
Lec, W F 12:20; lab, M 12:20–3:20. L. H. Irwin.
Highway systems, planning, economy analysis, road location and geometric design, traffic engineering, drainage design, and soil engineering. Introduction to highway materials, pavement design, and highway maintenance.

492 Bituminous Materials and Pavement Design Spring. 3 credits. Prerequisite: concurrent registration in Engineering CEED301 or permission of instructor.
Lec, W F 12:20; lab, M 12:20–3:20. L. H. Irwin.
Properties of asphalts, aggregates, and bituminous mixtures; bituminous mixture design. Seal coat and surface treatment design. Soil stabilization methods. Flexible pavement design methods, rigid pavement design methods, pavement design for frost conditions.

497 Special Problems in Agricultural Engineering Fall or spring. 1 credit or more. Normally reserved for seniors in upper two-fifths of their class.
Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade. Prerequisite: adequate ability and training for the work proposed.
Staff.
Special work in any area of agricultural engineering on problems under investigation by the department or of special interest to the student, provided, in the latter case, that adequate facilities can be obtained.

501—502 M.P.S. Project Fall and spring. 1–6 credits. Required of each M.P.S. candidate in the field.
Hours to be arranged. Staff.
A comprehensive project utilizing applied problems pertinent to agricultural engineering.

551–552 Agricultural Engineering Design Project Fall and spring. 6 credits. Prerequisite: admission to the M.Eng.(Agr.) degree program or equivalent preparation.
Hours to be arranged. L. D. Albright and staff.
Comprehensive design projects dealing with existing engineering problems in the field. Emphasis is on the formulation of alternative design proposals that include consideration of economics, nontechnical factors, engineering analysis, and complete design for the best design solution.

[651 Similitude Methodology Fall. 3 credits. Not offered 1980–81.
Lecs, M W 8; lab to be arranged. R. B. Furry.
Similitude methodology, including the use of dimensional analysis to develop general equations to define physical phenomena; model theory, distorted models, and analogies, with an introduction to a variety of applications in engineering.]

652 Instrumentation Spring. 3 credits. Prerequisite: electrical systems or permission of instructor.
Lecs, T R 12:20; lab to be arranged. N. R. Scott.
The application of instrumentation concepts and systems to physical and biological measurements. Characteristics of instruments, signal conditioning and interfacing, shielding and grounding, transducers, data acquisition systems, microprocessors, and radiotelemetry are considered.

[672 Drainage Engineering Spring. 4 credits. Prerequisite: Agricultural Engineering 471 or permission of instructor. Offered alternate years. Not offered 1980–81.
Lecs, M W F 10:10; lab, F 1:25–4:25.
T. S. Steenhuis, R. D. Black.
Analysis and design of surface, subsurface, and combined drainage systems, with emphasis on agricultural applications. The elements of surface, channel, and porous media flow are analyzed, as well as entire systems of collectors, storages, pumps, and methods of overflow protection for large areas. Effect of drainage on water quality is reviewed.]

673 Irrigation Engineering Spring. 3 or 4 credits. Prerequisites: Agronomy 200 and Agricultural Engineering 471 or permission of instructor. Offered alternate years.
Lecs, M W F 10:10; lab, F 1:25–4:25. R. D. Black, T. S. Steenhuis.
Analysis and design of irrigation systems. Soil-plant-water relationships, water quality, water supplies, water delivery systems, and water distribution system are analyzed.

677 Treatment and Disposal of Agricultural Wastes Fall. 3 credits. Prerequisite: permission of instructor.
3 lecs, hours to be arranged. R. C. Loehr.
Emphasis is on the causes of agricultural waste problems and the application of fundamentals of treatment and control methods to minimize related pollution. Fundamentals of biological, physical, and chemical pollution control methods are applied to animal, food production, and food-and fiber-processing wastes, using examples of designs of management systems.

678 Nonpoint Source Water Quality Models Spring. 1–3 credits. Limited to upperclass or graduate students. Prerequisites: computer programming, a year of calculus, and permission of instructor. S-U grades optional.
Lecs, M W F 9:05. D. A. Haith.
Mathematical models for analysis of agricultural and urban noinpoint sources. Three 1-credit sequential units: (1) stormwater models — computer models of runoff and moisture balances; (2) basic nonpoint source models — simple models for urban and agricultural runoff, land application of wastes; (3) agricultural simulation models — pesticides, nutrients, and salinity.

679 Use of Land for Waste Treatment and Disposal Spring. 3 credits. Prerequisite: permission of instructor.
Lecs, T R 3:35–4:50. Staff.
Covers the socio-legal-technical factors, the properties of land and crop systems that make land application of wastes a viable alternative, and the use of fundamentals in the development of regulations and the design of full-scale units.

685 Biological Engineering Analysis Fall. 4 credits. Prerequisite: Engineering T&AM 311 or permission of instructor.
T R 10:10–11:40. R. E. Pitt.
Engineering problem-solving strategies and techniques are explored. The student solves several representative engineering problems that inherently involve biological properties. The mathematical modeling emphasizes problem formulation and interpretation of results. The student's knowledge of fundamental principles is used extensively. Principles of feedback control theory are applied to biological systems.

700 General Seminar Fall. Noncredit.
M 12:20. N. R. Scott.
Presentation and discussion of research and special developments in agricultural engineering and related fields.

701 Special Topics in Agricultural Engineering Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. Staff.
Topics are arranged by the staff at the beginning of the term.

750 Orientation for Research Fall. 1 credit. Limited to newly joining graduate students. S-U grades only.
Lecs: first 5 weeks, M 3:20; remainder, M R.
G. E. Rehkugler.
An introduction to departmental research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

761 Power and Machinery Seminar Spring. 1 credit. Limited to graduate students. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. W. W. Gunkel.
Study and discussions of research and new developments in agricultural power and machinery.

771 Soil and Water Engineering Seminar Fall or spring. 1–3 credits. Prerequisite: graduate status or permission of instructor. S-U grades optional.
Hours to be arranged. Staff.
Study and discussion of research or design procedures related to selected topics in irrigation, drainage, erosion control, hydrology, and water quality.

[775 Agricultural Waste Management Seminar Spring. 1 credit. Prerequisite: permission of instructor. S-U grades only. Not offered 1980–81.
Hours to be arranged. Staff.
Management of agricultural wastes, with emphasis on physical, chemical, biological, and economic factors affecting waste production, treatment and handling, utilization, and disposal.]

781 Agricultural Structures and Related Topics Seminar Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only.
Disc to be arranged. L. D. Albright.
Consideration of farmstead production systems, with emphasis on biological, economic, environmental, and structural requirements.

785 Biological Engineering Seminar Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only.
Disc to be arranged. N. R. Scott, J. R. Cooke.
The interaction of engineering and biology, especially the environmental aspects of plant, animal, and human physiology, are examined in order to improve communication between engineers and biologists.

Agronomy

R. F. Lucey, chairman; M. Alexander, W. H. Allaway, D. R. Bouldin, B. E. Dethier, W. B. Duke, J. M. Duxbury, G. W. Fick, D. L. Grunes, W. K. Kennedy, W. R. Knapp, W. W. Knapp, J. Kubota, D. J. Lathwell, A. C. Leopold, D. L. Linscott, M. B. McBride, R. D. Miller, R. L. Obendorf, G. W. Olson, A. B. Pack, D. A. Paine, J. H. Peverly, W. S. Reid, S. J. Riha, T. W. Scott, R. R. Seaney, T. L. Setter, P. L. Steponkus, F. N. Swader, A. Van Wambeke, R. M. Welch, M. J. Wright, R. W. Zobel

Atmospheric Sciences

101 Basic Principles of Meteorology Fall. 3 credits. Limited to 140 students.
Lecs, T R 11:15; lab, M T W or R 1:25–4:25. B. E. Dethier.
A simplified treatment of the structure of the atmosphere: heat balance of the earth; general and secondary circulations; air masses, fronts, and cyclones; hurricanes, thunderstorms, tornadoes, and atmospheric condensation. In the lab, emphasis is on techniques of analysis of weather systems.

103 Basic Principles of Meteorology, Laboratory Fall. 1 credit. Prerequisite: an introductory course in meteorology without a lab.
M T W R 1:25–4:25. B. E. Dethier.
Techniques of analysis of weather systems and the application of dynamical and empirical methods of predicting the daily atmospheric circulation.

202 Dynamic Climatology Spring. 3 credits. Prerequisite: Atmospheric Sciences 101.
M W F 11:15. B. E. Dethier.
The first part of the course is devoted to a description of world climates in terms of global distribution of radiation, temperature, pressure, and wind; precipitation; and air masses. The second part of the course relates climates and climatic anomalies to planetary, regional, and local circulations.

314 Agricultural Meteorology Spring. 3 credits. Limited to 35 students.
T R 10–11:25. A. B. Pack.
An introduction to the relationships of radiant energy, temperature, wind, and moisture in the atmosphere near the ground. The interplay between physical processes of the atmosphere, plant canopies, and soil is examined. Moisture relationships in the atmosphere-soil-plant continuum, the effects of environmental modification, and the bioclimatic requirements of plants are also discussed.

325–326–327–328 Meteorological Communications 325 and 327, fall; 326 and 328, spring. 1 credit each semester. Primarily for undergraduate meteorology majors. S-U grades optional.
Hours to be arranged. Staff.
The student becomes acquainted with facsimile, teletype, and satellite receiving equipment and the data products used in weather forecasting.

411–412 Theoretical Meteorology I and II Fall and spring. 3 credits each semester. Prerequisites: a year each of calculus and physics; 411 is prerequisite to 412 unless permission is obtained from instructor.
M W F 10:10. W. W. Knapp.
Topics include thermodynamics of dry air, water vapor, and moist air; hydrostatics and stability; meteorological coordinate systems; variation of wind and pressure fields in the vertical; winds in the planetary boundary layer; surfaces of discontinuity; mechanisms of pressure change; vorticity and circulation.

417 Physical Meteorology Fall. 3 credits. Prerequisite: a year each of calculus and physics. Offered alternate years.
M W F 12:20. W. W. Knapp.
Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include composition and structure of the atmosphere, atmospheric optics, acoustics and electricity, solar and terrestrial radiation, and principles of radar probing of the atmosphere.

430 Synoptic Meteorology Spring. 4 credits. Prerequisites: either Atmospheric Sciences 411 and 412 or permission of instructor.
Lecs, M R 1:25; lab, R 2:30–4:25. D. A. Paine.
The application of quasi-geostrophic theory as a diagnostic and forecast method, including the use of minicomputer products derived from the barotropic, baroclinic, and primitive equation numerical models. Lab work includes surface and upper air analyses and thickness and vorticity computations using radiosonde data documenting macroscale cyclogenesis.

432 Isentropic Theory and Analysis Spring. 4 credits. Prerequisite: Atmospheric Sciences 430 or permission of instructor.
Lecs, T F 1:25; lab, T 2:30–4:25. D. A. Paine.
The conservation laws for mass, energy, and momentum in constant entropy coordinates. Derivation and construction of adiabatic versus diabatic trajectories. Ertel's potential vorticity theorem evaluated by the quasi-Lagrangian trajectory technique. The lab employs the Atmospheric Sciences 430 storm data to contrast constant pressure and isentropic methods of analysis.

464 Biometeorology Spring. 2 credits. Prerequisite: with permission of the instructor (no course prerequisites).
Lec, W 1:25; lab, W 2:30–4:25. D. A. Paine.
Interactivity between the atmosphere and biosphere is of central concern when considering many of the challenges of this decade, such as acid rain, severe winter cold stress, fossil fuel burning, and CO_2 increase. Empirical and theoretical models of such interactivity will be presented. A systems-level approach to environmental protection decisions will be emphasized.

499 Undergraduate Research in Meteorology Fall and spring. 1–3 credits.
Staff.
Required of honor students in the physical sciences majoring in meteorology.

650 Special Topics in Meteorology and Climatology Fall or spring. 1 or more credits.
Staff.
A study of meteorological topics more advanced than or different from those in other courses. Subjects depend on the background and desires of those enrolled.

691 Seminar in Meteorology Fall or spring. Prerequisite: permission of instructor.
Hours to be announced. B. E. Dethier.
Subjects such as weather modification, paleoclimatology, and atmospheric pollution.

962 Research in Meteorology Fall or spring. 1 or more credits.
Staff.
Thesis research.

Crop Science

311 Grain Crops Fall. 4 credits. Prerequisite: Agronomy 200 or Biological Sciences 241.
Lecs, M W F 10:10; lab, M T or W 1:25–4:25. One or two field trips during lab periods (until 5 p.m. or on weekends). Fall, R. L. Obendorf.
Principles of field crop growth, development and maturation, species recognition, soil and climatic adaptations, liming and mineral nutrition, weed control, cropping sequences, management systems, and crop improvement are considered. Grain, protein, fiber, and sugar crops are emphasized.

312 Forage Crops Spring. 4 credits. Prerequisites: Agronomy 200 or Biological Sciences 241. Recommended: Animal Science 112.
Lecs, M W F 11:15; lab, M T or W 1:24–4:25. One field trip during a lab period (until 5 p.m.) or on a weekend. G. W. Fick.
The production and management of crops used for livestock feed are considered in terms of establishment, growth, maintenance, harvesting, and preservation. Forage grasses, forage legumes, and corn are emphasized, and consideration is given to their value as livestock feed in terms of energy, protein, and other nutritional components.

314 Production of Tropical Crops Spring. 3 credits. Prerequisite: a course in crop production.
Lecs, M W F 10:10. M. J. Wright.
An introduction to the characteristics and culture of the principal food staple crops of the tropics and subtropics and of some of the crops grown for export. Vegetables and fruits are not emphasized.

315 Weed Science Fall. 3 credits. Prerequisites: Agronomy 200, and Biological Sciences 103 and 104 or Biological Sciences 241.
Lecs, T R 8; lab, M T or W 2–4:25. W. B. Duke.
Principles of weed science are examined. Emphasis is given to (A) weed ecology; (B) chemistry of herbicides in relation to effects on plant growth; and (C) control of weeds in all crops. Lab covers weed identification, herbicide selectivity, herbicide injury symptoms, and farm pesticide problem solving.

[317 Seed Science and Technology Fall. 3 credits. Prerequisite: Biological Sciences 241 or equivalent. Offered alternate years. Not offered in 1980–81.
Lecs, T R 11:15; lab, R 1:25–4:25. R. L. Obendorf.
The principles and practices involved in the production, harvesting, processing, storage, testing,

quality management, certification, and use of high quality seed from improved cultivars. Information will be applicable to various kinds of agricultural seeds.]

371 Undergraduate Research in Crop Science Fall or spring. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to course enrollment material.
Hours to be arranged. Staff.
Independent research on current problems selected from any phase of crop science.

[610 Physiology of Environmental Stresses Spring. Prerequisite: Biological Sciences 242 or 341. 3 credits. Offered alternate years. Not offered 1980–81.
Lecs, T R 10:10. P. L. Steponkus.
A study of the responses of plants to environmental stresses, including chilling, freezing, high temperature, and drought. Emphasis is on the physiological and biochemical basis of injury and plant resistance mechanisms at the whole-plant, cellular, and molecular levels.]

[611 Crop Simulation Modeling Fall. 3 credits. Prerequisite: Biological Sciences 242 or 341. Recommended: Computer programming experience. Offered alternate years. Not offered 1980–81.
M W F 11:15. G. W. Fick.
A study of existing crop models is followed by development and refinement of programs representing the students' work. The computer language CSMP is used. Emphasis is on quantitative formulation and testing of complex hypotheses related to crop growth. Carbon exchange, transpiration, microclimate, soil water supply, root functions, and dry-matter distribution in growing crops are covered.]

612 Grain Formation Spring. 3 credits. Prerequisite: plant physiology.
M W F 12:20. R. L. Obendorf.
Morphology, physiology, and biochemistry of cereal, legume, and oil seed formation, composition, storage, and germination. Emphasis will be on the deposition of seed reserves during seed formation, stabilization of reserves during storage, and mobilization of reserves during germination. Coverage will range from practical, "on-farm" problems to molecular biology.

[613 Ecology and Physiology Yield Fall. 2 credits. Prerequisites: Agronomy 111 and 200 and Biological Sciences 242. Offered alternate years. Not offered 1980–81.
Two 2-hour class meetings a week for last 10 weeks, hours to be arranged. T. L. Setter.
A study of special techniques used to obtain and analyze physiological data on crop plant responses to environmental conditions occurring in the field.]

651 Special Topics in Crop Science Fall or spring. 1–6 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Hours to be arranged. Staff.
The topic is arranged at the beginning of the term for individual study or for group discussions.

761 Graduate Research in Crop Science Fall, spring, or summer. Credit by arrangement. Limited to members of the graduate field.
Hours to be arranged.

790 Agronomy Seminar Noncredit.
See course description in soil science section below.

Related Courses in Other Departments

Forages of the Tropics for Livestock Production (Animal Sciences 403)

Special Studies of Problems of Agriculture in the Tropics (International Agriculture 602)

Soil Science

200 Nature and Properties of Soils Fall or spring. 4 credits. Prerequisite: Chemistry 103, 207, or 215. S-U grades optional.
Lecs, M W F 9:05; lab, M T W or R 1:25–4:25. Fall, D. J. Lathwell; spring, T. W. Scott.
A comprehensive introduction to the field of soil science, with emphasis on scientific principles and their application in solutions of practical soil management problems.

301 Identification, Appraisal, and Geography of Soils Fall. 4 credits. Prerequisite: Agronomy 200 or permission of instructor. S-U grades optional.
Lec, M W F 10:10; lab, W 2–4:25; field trips. Staff.
The soil as a natural body. Principles of identification and classification of geographic units of soil and interpretation of such units for applied objectives. Geography of major kinds of soil of North America in relation to environment and cultural patterns. Lab exercises and field trips to assist in identifying and interpreting soils.

302 Field Identification of Soils Fall. 1 credit. Prerequisite: Agronomy 200.
R 1:25–4:25. Staff.
The principles for field identification of soil properties, profiles and landscapes are presented. A series of soil pits will be examined, described, classified, and interpreted in the field.

321 Soil and Water Conservation Spring. 2 credits. Prerequisites: Agronomy 200 and concurrent registration in Agricultural Engineering 321. S-U grades optional.
M W 8. W. H. Allaway.
A study of the principles and practices used in soil and water conservation, agronomic aspects of erosion control, water management, storage, drainage, and irrigation.

324 Soil Fertility Management Fall. 3 credits. Prerequisite: Agronomy 200 or permission of instructor.
M W F 9:05. D. R. Bouldin.
An integrated discussion of soil–crop yield relationships, with emphasis on the soil as a source of mineral nutrients for crops and the role of fertilizers and manure in crop production.

331 Aquatic Plant Management Fall. 3 credits. Prerequisites: Biological Sciences 101–102 and Chemistry 103–104 or equivalents.
T R 11:15; T 1:25–4:25. J. H. Peverly.
The chemistry and physiology of higher aquatic plants are studied, from the inorganic solid, solution, and gaseous phases of the environment to cellular and subcellular levels of plants. Application of the basic physical and chemical concepts, presented to predict effects on aquatic plant growth, are illustrated in lab and field situations.

401 Geography and Appraisal of Soils of the Tropics Spring. 3 credits. Prerequisite: Agronomy 200 or equivalent. S-U grades optional.
Lecs, W F 12:20; disc, F 2:30–4:25.
A. Van Wambeke.
The character of principal kinds of soils in the major regions of the tropics. Soil properties are related to the position in the landscape and to profile genesis. Emphasis is on soil properties as a basis for interpretation of crop management requirements and production potential. Lectures introduce principles whose applications are examined through discussions, problem solving, and independent reading.

403 Organic Soils Fall. 2 credits. Prerequisite: Agronomy 200. Offered alternate years.
W 1:25–4:25; some field trips will not return before 5:30. J. M. Duxbury.
A combination of field study and discussion of the genesis, ecology, physical and chemical properties, agricultural uses, and management of organic soils.

404 Forest Soils Fall. 2 credits. Prerequisite: Agronomy 200 or permission of instructor.
Lecs, T R 8; lab, M or W 2:25–4:25. Some field trips may not return before 5:30. S. J. Riha.
Ecology of forest soils. Application of basic physical and chemical principles to the study of energy, water, and nutrient budgets of forest ecosystems. Implications for forest management. Labs consist of field trips and problem solving.

[406 Soil Microbiology, Lectures Spring. 3 credits. Prerequisite: Agronomy 200 or Microbiology 290. Offered alternate years. Not offered 1980–81.
M W F 10:10. M. Alexander.
A study of the major groups of soil microorganisms, their ecological interrelationships, and the biochemical functions of soil organisms.]

410 Microbial Ecology Spring. 3 credits. Prerequisite: an elementary course in some facet of microbiology. Offered alternate years.
M W F 10:10. M. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to the behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems.

480 Management Systems for Tropical Soils Spring. 3 credits. Prerequisite: Agronomy 401 or permission of instructor. S-U grades optional. Offered alternate years.
Lec, W F 8; disc, W 2:30–4:25. A. Van Wambeke.
Land evaluation in tropical areas; water requirements in semiarid tropics. Management of tropical soils in relation with nitrogen, acidity, liming, phosphorus, and other nutrients. Effects of cropping systems on soils, soil conservation methods, and erosion control.

497 Special Topics in Soil Science Fall or spring. 1–6 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Hours to be arranged. Staff.
The topics are arranged at the beginning of the term for individual study or for group discussions.

499 Undergraduate Research in Soil Science Fall or spring. Credit to be arranged. Written permission from the staff member who will supervise the work and assign the grade must be attached to course enrollment material.
Hours to be arranged. Staff.
Independent research on current problems selected from any phase of soil science.

[506 Use of Soil Information and Maps as Resource Inventories Fall. 2 credits. S-U grades optional. For anyone interested in using soils. Offered alternate years. Not offered 1980–81.
T R 11:15. G. W. Olson.
Principles, practices, and research techniques in interpreting soil information and maps for planning, developing, and using areas of land.]

602 Chemical Methods of Soil Analysis Spring. 3 credits. Prerequisites: Agronomy 200 and Chemistry 207–208 or equivalents.
T R 1:25–3:30. M. B. McBride.
Lectures and lab exercises present the fundamental concepts and analytical methods of soil chemistry.

603 Morphology, Genesis, and Classification of Soils Spring. 3 credits. Prerequisite: Agronomy 301 or permission of instructor. Offered alternate years.
T R 10:30–12. Staff.
Principles of soil classification, reactions, and processes of soil genesis, soil taxonomy, and development and significance of major groups of soils of the world.

606 Advanced Soil Microbiology Fall. 1 credit. Prerequisite: Agronomy 406 or permission of instructor. S-U grades only for graduate students.
T 12:20. M. Alexander.
Discussions of current topics in special areas of soil microbiology. Particular attention is given to biochemical problems in microbial ecology.

607 Soil Physics Fall. 3 credits. Prerequisites: Agronomy 200 and a year of college physics or permission of instructor. Offered alternate years.
M W F 11:15. R. D. Miller.
A study of physical properties and processes in soils, with emphasis on basic principles.

608 Water Status in Plants and Soils Fall. 2 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years.
Lec, 1 hour to be arranged; lab, R 1:25–4:25 or as arranged. R. D. Miller, T. L. Setter.
Techniques for field appraisal of the status of water in plants and soil, including methods used in evapotranspiration studies.

[609 Soil Organic Matter Fall. 2 credits. Prerequisites: Agronomy 200 and Chemistry 357–358 or equivalent. Offered alternate years. Not offered 1980–81.
T R 9:05. J. M. Duxbury.
A discussion of current concepts of the nature, mode of formation, dynamics, and role of organic matter in soils. Some consideration is given to the behavior of manufactured organic chemicals in the soil environment.]

701 Soil Chemistry and Mineralogy Fall. 3 credits. Prerequisites: Agronomy 200 and a year of physical chemistry, or permission of instructor. Offered alternate years.
T R 10:10–11:25. M. B. McBride.
Chemical properties of soils, with emphasis on structure and surface chemistry of soil minerals, ion exchange, mineral-solution equilibria, and adsorption reactions of soil clays and oxides.

724 Soil Fertility Advanced Course Spring. 3 credits. Prerequisite: graduate status with a major or minor in agronomy. Offered alternate years.
T R 8:30–9:55. D. R. Bouldin.
A study of selected topics in soil-crop relationships, with emphasis on concepts of soil fertility, interpretation of experimental data, and soil fertilizer chemistry.

760 Graduate Research in Soil Science Fall or spring. Credit by arrangement. Limited to students in the graduate field.
Hours by arrangement.

790 Agronomy seminar Fall or spring. Noncredit. Required of graduate students majoring or minoring in the department.
T 4.

Related Course in Another Department

Special Studies of Problems of Agriculture in the Tropics (International Agricultural Development 602)

Animal Sciences

Department of Animal Sciences: R. J. Young, chairman; H. R. Ainslie, B. J. Apgar, D. E. Bauman, D. H. Beermann, R. D. Boyd, W. F. Brannon, W. R. Butler, L. E. Chase, W. B. Currie, J. M. Elliot, R. W. Everett, R. H. Foote, D. G. Fox, R. C. Gorewit, W. Hansel, H. F. Hintz, D. E. Hogue, R. E. McDowell, W. G. Merrill, R. P. Natzke, E. A. Oltenacu, P. A. Oltenacu, R. L. Quaas, S. W. Sabin, H. F. Schryver, S. T. Slack, D. R. Smith, C. J. Sniffen, J. R. Stouffer, M. L. Thonney, H. F. Travis, D. R. Van Campen, N. L. VanDemark, P. J. Van Soest, L. D. VanVleck, R. G. Warner

Department of Poultry Sciences: R. C. Baker, chairman; R. E. Austic, S. E. Bloom, G. F. Combs, Jr., D. L. Cunningham, R. R. Dietert, H. G. Ketola, J. A. Marsh, C. E. Ostrander, J. M. Regenstein, E. A. Schano, A. van Tienhoven

100 Introductory Animal Science Fall. 3 credits. For beginning students. S-U grades optional.
Lecs, W F 10:10; lab, T R or F 2–4:25. J. M. Elliot.
An introduction to animal science dealing with domestic animals and with current practices and problems of the livestock and meat industries. The place of the physical and biological sciences in animal agriculture is discussed. Emphasis is on the nutrition, physiology, breeding, and management of dairy cattle, beef cattle, sheep, swine, and horses.

105 Contemporary Perspectives of Animal Science Spring. 1 credit. Limited to freshmen, sophomores, and first-year transfers.
T 1:25, W 12:20. Staff.
A forum to discuss the contemporary and future role of animals in relation to human needs and career planning.

112 Livestock Nutrition Spring. 4 credits. Prerequisite: Chemistry 103 or 207. Recommended: Animal Science 100.
Lecs, M W F 10:10; lab, M T W R or F 2–4:25.
D. E. Hogue.
An introduction to animal nutrition, covering fundamentals of nutrition, the composition of feeds, and feeding standards and their application to various forms of production in dairy and beef cattle, sheep, swine, and horses.

113 Nutrition of Companion Animals Fall, weeks 1–7. 1 credit. Prerequisite: Animal Science 112 or equivalent. S-U grades optional.
W 7:30–9:25 p.m. H. F. Hintz.
Nutrition of companion animals, with emphasis on the dog and cat. Digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.

200 Animal Physiology Fall. 3 credits. Limited to sophomores and juniors except with permission of instructor. Prerequisite: a year of college biology.
Lecs, M W F 9:05. W. B. Currie.
General animal physiology with emphasis on physiologic concepts and the understanding of animal function in physiologic terms. Lectures and discussion sections are designed to encourage independent supportive study. Groups of students will prepare and present demonstrations on subjects of their own choosing to the class. This course provides a basis for the study of nutrition and production and the more specialized physiology courses in animal science.

220 Animal Reproduction and Development Spring. 4 credits. Each lab limited to 36 students. Prerequisite: a year of college biology or equivalent.
Lecs, T R 9:05; demonstration and lab, M T W or R 2–4:25 or T 10:10–12:35 or F 12:20–2:45.
R. H. Foote.
An introduction to the comparative anatomy and physiology of reproduction of farm animals. The life cycle from fertilization through development and growth to sexual maturity is studied, with emphasis on physiological mechanisms involved, relevant genetic control, and the application to fertility regulation of animal and human populations. An audio-tutorial lab is available for independent study to prepare for lab experiments.

221 Introductory Animal Genetics Fall. 3 credits. Prerequisite: a year of college biology.
Lecs, T R 9:05; disc, W R or F 2–4:25.
E. J. Pollak.
An examination of basic genetic principles and their application to the improvement of domestic animals, with emphasis on the effects of selection and mating systems on animal populations.

230 Poultry Biology Spring. 3 credits.
Lecs, T R 11:15; lab, W 2–4:25. Field trips during lab periods may last longer. G. F. Combs, Jr.
Designed to acquaint the student with the scope of the poultry industry. Emphasis is on the principles of avian biology and their application in the various facets of poultry production.

250 Dairy Cattle Fall. 3 credits. S-U grades optional.
Lecs, T R 10:10; lab, M T R 1:25–4. Staff.
Introduces the major components of the dairy industry. Topics discussed include breeding, feeding, reproduction, milking, milk secretion, replacement rearing, disease prevention, and record keeping. Laboratories are designed to provide limited practice in husbandry techniques.

251 Dairy Cattle Selection and Type Evaluation Spring. 3 credits.
Lab, W 12:20–4:25. 1 S all-day field trip. Staff.
Emphasis on conformation characteristics for practice type to achieve wearability for high lifetime production. Practical sessions include planned trips to outstanding herds in the state.

265 Horses Spring. 3 credits. Prerequisite: Animal Science 100 or permission of instructor.
Lecs, T R 9:05; lab, R 1:25–4:25. H. F. Hintz, J. E. Lowe.
Selection, management, feeding, breeding, and training of light horses.

290 Meat and Meat Products Spring. 3 credits.
Lecs, T R 9:05; lab, M T or W 1:25–4:25.
J. R. Stouffer.
An introduction to meat science through a study of the characteristics of meat from slaughter to consumption. Structure, composition, inspection, grading, preservation, cutting, and processing are included. A trip to commercial meat plants is taken.

321 Seminar on Genetics of the Horse Spring. 1 credit. Prerequisite: Animal Science 265 or permission of instructor. Recommended: Animal Science 221 or Biological Sciences 281.
T or W 9:05. L. D. VanVleck.
A discussion of genetics of the horse, with special reference to simply inherited traits and selection for quantitative traits.

330 Commercial Poultry Production Fall. 1 credit. Prerequisite: Animal Science 100, 230, or permission of instructor. Offered alternate years.
F 2–4:25. Field trips. D. L. Cunningham.
The course is designed to provide an understanding of what takes place and is required in a commercial egg production operation.

350 Dairy Cattle Production and Management Spring. 3 credits for students with credit in Animal Science 250 or equivalent; otherwise 4 credits. Prerequisites: either Animal Science 112, 220, or 221 or permission of instructor. Recommended for students with limited dairy experience: Animal Science 250.
Lecs, M W F 9:05; lab, T W 1:25–4:25. 1 all-day field trip. W. G. Merrill, J. M. Elliot, L. D. VanVleck.

Analysis of breeding, feeding, housing, and management systems for economical production; evaluation of milking systems, including principles of milk secretion and milking procedures. Includes farm visits to observe application of modern technology in operation.

352 Advanced Dairy Cattle Selection Fall. 3 credits. Prerequisite: Animal Science 251 and permission of instructor.
Practice hours to be arranged. S. T. Slack.
Emphasis on additional training in comparative judging for students selected from Animal Science 251 to represent Cornell in intercollegiate judging competition.

360 Beef Cattle Spring. 3 credits. Prerequisite: Animal Science 100, 110, 220, 221, or permission of instructor.
Lecs, T R 10:10; lab, M T 2–4:25. M. L. Thonney.
Emphasis is on the management of reproduction, nutrition, and selection in beef cattle enterprises. A cattle growth model is studied. Labs acquaint students with the management skills of a beef operation. Students are required to spend several days during the semester feeding, observing calving, and caring for cattle.

370 Swine Production Fall. 3 credits. Limited to 85 students; each lab limited to 45 students. Prerequisite: Animal Science 112, 220, 221 *or* permission of instructor.
Lecs, T R 11:15; lab, T or W 2–4:25. R. D. Boyd.
The objective is to provide an opportunity to acquire practical knowledge and a technical basis for decisions in various types of swine enterprises. Emphasis on the various production systems, selection and breeding programs, reproductive management, nutrition, herd health and housing facilities. Labs are designed to extend and apply principles discussed in lecture and to provide students with the opportunity to perform management skills.

380 Sheep Fall. 3 credits. Prerequisite: Animal Science 100. Recommended: Animal Science 112, 220, and 221.
Lec, T R 10:10; lab and disc periods, M 1:25–4:25 every other week. D. E. Hogue.
The breeding, feeding, management, and selection of sheep. Lectures and lab are designed to give the student a practical knowledge of sheep production as well as the scientific background for improved practices.

390 Meat Animal and Carcass Evaluation Fall. 2 credits. Prerequisite: Animal Science 100 or permission of instructor.
Lec and lab, W 2–4:25. J. R. Stouffer.
Principles and techniques of meat animal and carcass evaluation. Grading standards, meat quality, and yield factors and criteria used to evaluate growth, development, and fattening will be covered in lectures and demonstrations.

400 Livestock Production in Warm Climates Spring. 3 credits. Prerequisite: either Animal Science 112, 220, or 221 or permission of instructor.
Lecs, T R 10:10; disc, W 1:25–3:20.
R. E. McDowell.
An analysis of the limitations the tropical environment imposes on livestock production; restrictions on contributions of animals to farm incomes owing to limitations in genetic potential; feed resources; and social structures. The role of animals on small farms and the interdependence of humans and animals for food, services, and nonfood products are stressed. The application of principles introduced in lectures are examined through discussions, problem solving, and independent study.

401 Seminar Dairy Production Spring. 1 credit. Limited to juniors and seniors.
Hours to be arranged. D. E. Bauman and staff.
Students, with the help of faculty members, complete a study of the research literature on topics of current interest in the dairy industry. Students make oral presentations of their findings.

402 Undergraduate Seminar Spring. 1 credit. Limited to advanced undergraduates. S-U grades optional.
Hours to be arranged. L. D. VanVleck.
A study of literature pertinent to special topics in animal science. Students are required to review the literature and to present oral and written reports.

[403 Forages of the Tropics for Livestock Production Spring. 3 credits. Limited to seniors and graduate students except by permission of instructor. Prerequisites: crop production and livestock nutrition. Offered alternate years. Not offered 1980–81.
Lecs, T R 12:20; disc, T 1:25. R. E. McDowell, P. J. VanSoest.
A review of tropical grasslands, sown pastures, and fodders and their use as feed resources; grass and legume characteristics; establishment and management of pastures and feed source alternatives; forage quality and utilization; problems of utilization of tropical forages as hays and silages.]

410 Principles of Animal Nutrition, Lectures Fall. 3 credits. Prerequisite: organic chemistry. Recommended: biochemistry or concurrent registration in a biochemistry course.
M W F 8; M 4:30 for students with a scheduling conflict only. 2 discs to be arranged. R. G. Warner.
The principles of nutrition are developed from a discussion of the biochemical and physiological interaction of the nutrients as they apply to the cell and the whole animal. Examples are selected from a broad range of animal species including humans.

411 Principles of Animal Nutrition, Laboratory Fall. 1 credit. Limited to 20 students. Prerequisite: concurrent registration in Animal Science 410.
Hours to be arranged. R. G. Warner, H. F. Hintz, R. E. Austic, H. F. Travis, G. F. Combs, Jr., H. F. Schryver, M. L. Thonney.
Lab problems with animals introduce the student to techniques of experimental nutrition.

415 Poultry Nutrition Spring. 1 credit. Prerequisite: Animal Science 410 or permission of instructor.
F 11:15. G. F. Combs, Jr.
A practical consideration of principles of nutrition applied to feeding poultry, including use of linear programming techniques in diet formulation.

419 Animal Cytogenetics Fall. 4 credits. Prerequisite: Animal Science 221, Biological Sciences 281, or permission of instructor.
Lec, T R 9:05; lab, T or W 1:25–4:25; 2 other hours to be arranged. S. E. Bloom.
A study of normal and abnormal chromosomes in higher animals. Lecture topics include chromosome organization, chromosome movement, cytogenetics of abortuses, parthenogenesis, chromosomes and cancer, mitotic and meiotic errors, and human clinical cytogenetics. In labs students obtain chromosome preparations from various animals and use cytochemical and photographic methods for karyotype analysis.

420 Quantitative Animal Genetics Fall. 3 credits.
Lecs, T R 11:15; lab, W R or F 2–4:25.
L. D. VanVleck.
A consideration of problems involved in improvement of animals, especially farm animals, through application of the theory of quantitative genetics with emphasis on selection index.

421 Seminar in Animal Genetics Fall. 1 credit. Prerequisite: Animal Science 221 or concurrent registration in Animal Science 420.
Hours to be arranged. L. D. VanVleck, R. W. Everett.
A discussion of applications of principles of quantitative genetics and animal breeding to specific types of animals such as dairy animals, meat animals, and horses.

422 Research Techniques in Quantitative Animal Genetics Fall. 1 credit. Prerequisite: Animal Science 420 or concurrent registration in Animal Science 420.
R 12:20. L. D. VanVleck.
An introduction to methods of research in quantitative genetics and animal breeding, including estimation of heritability, repeatability, and genetic and phenotypic correlations.

427 Fundamentals of Endocrinology Fall. 4 credits (3 credits without lab). Each lab limited to 55 students. Prerequisite: human or veterinary physiology, or permission of instructor.
Lecs, M W F 9:05; lab, T or R 1:25–4:25.
W. R. Butler.
The physiology of the endocrine glands and the roles played by each hormone in the regulation of normal body processes. The laboratory work consists of a series of experiments designed to illustrate the basic principles of endocrinology.

430 Artificial Breeding of Farm Animals Fall, starting August 25. 2 credits. Prerequisites: Animal Science 220 and 221 or their equivalent. Permission of the instructor must be obtained at course enrollment.
Lecs, T R 9:05; labs, M T W R F 8:30–4:30 from August 25–29. R. H. Foote.
Principles of artificial breeding and practical animal and laboratory experience in semen collection, semen evaluation, semen freezing, and artificial insemination of farm animals.

440 Application of Systems Analysis in Livestock Production Management Fall. 3 credits. Limited to 30 students. Prerequisites: Mathematics 105 and courses in livestock production or permission of instructor.
M W F 9:05. P. A. Oltenacu.
All-embracing systems concepts are applied to livestock production management. The use of mathematical modeling and simulation in solving management problems is illustrated with practical cases. Emphasis is on the principles behind the systems approach and not the technique's methodology.

450 Immunophysiology Spring. 3 credits. Prerequisite: course work in immunology or animal physiology or permission of instructor.
Lecs, M W F 11:15. J. A. Marsh.
Emphasis on the development and regulation of the immune system and the physiological parameters affecting and affected by immune functioning. Major topics include developmental immunology, immunoregulation, immunological involvement in reproduction and gonadal function, interrelationships between immune and endocrine functioning, and the immunology of aging. Other topics include tumor and transplantation immunology and autoimmune disease.

451 Physiology and Biochemistry of Lactation Spring. 3 credits. Prerequisite: either Animal Science 220 and Biological Sciences 231 or permission of instructor.
Lecs, T R 9:05; lab, R 2–4:25. R. C. Gorewit.
Emphasis is on mammary gland development, anatomy, physiological control of milk secretion, and biochemical synthesis of milk constituents in lab and farm animals.

452 Comparative Physiology of Reproduction of Vertebrates (also Biological Sciences 452) Spring. 3 credits. Prerequisite: Animal Science 427 or permission of instructor.
Lecs, M W F 1:25. One prelim at 7:30 p.m.
A. van Tienhoven.
Sex and its manifestations. Neuroendocrinology of reproduction, sexual behavior, gametogenesis,

fertilization, embryonic development, care of the zygote environment and reproduction, immunological aspects of reproduction.

454 Comparative Physiology of Reproduction of Vertebrates, Laboratory (also Biological Sciences 454) Spring. 2 credits. Prerequisite: Animal Science 452, concurrent registration in Animal Science 452, or permission of instructor.
Hours to be arranged; organizational meeting F 2:30 first week of semester. A. van Tienhoven.
Provides students with an opportunity to independently design and execute experiments with limited objectives.

486 Immunogenetics (also Biological Sciences 486) Spring. 3 credits. Limited to 25 students. Prerequisites: a course in immunology and Animal Science 221 or Biological Sciences 281, or permission of instructor.
Lecs, M W F 9:05; disc, W or R 12:20. R. R. Dietert.
The genetic control of a variety of cellular antigens and their use in understanding biological and immunological functions. The genetics of antibody diversity, antigen recognition, immune response, transplantation, and disease resistance.

490 (392) Commercial Meat Processing Fall. 3 credits. Prerequisite: Animal Science 290 or permission of instructor.
Lecs, T R 9:05; lab, M T or W 1:25–4:25. Field trip to commercial meat processing plants.
D. H. Beermann.
A study of the classification, formulation, and production of commercially available processed meat products. Physical and chemical characteristics of meat and nonmeat ingredients, their functional properties, various methodologies, microbiology, packaging, handling and storage, and quality assurance are discussed.

497 Special Topics in Animal Sciences Fall or spring. 3 credits maximum. Intended for students in animal sciences. Prerequisite: permission of instructor. S-U grades optional.
Staff.
May include individual tutorial study or a lecture topic selected by a professor. Since topics may change, the course may be repeated for credit.

498 (396) Undergraduate Teaching Fall or spring. 1 or 2 credits; 4 credits maximum during undergraduate career. Limited to students with grade point averages of at least 2.7.
Designed to consolidate the student's knowledge. A participating student assists in teaching a course allied with the student's education and experience. The student is expected to meet regularly with a discussion or lab section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

499 (395) Undergraduate Research Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with grade averages of at least 2.7.
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research,and prepare a report.

600 Research Fall or spring. Credit to be arranged.
Hours to be arranged. All members of animal science program area.

601 Proteins and Amino Acids in Nutrition (also Nutritional Sciences 601) Fall. 2 credits. Prerequisites: either physiology, biochemistry, and nutrition or permission of instructors.
W F 11:15. R. E. Austic, M. Morrison.
An advanced course in amino acid and protein nutrition with emphasis on the dynamic aspects of protein digestion, amino acid absorption, protein synthesis, amino acid metabolism, and nitrogen excretion. Discussions include nutritional interrelationships, amino acid and protein requirements, assessment of nutritional status, evaluation of protein quality, bioavailability of amino acids, and techniques of amino acid analysis. Emphasis is on basic principles and their application in animal and human nutrition.

604 Vitamins Fall. 2 credits.
T R 10:10. G. F. Combs, Jr.
A discussion of the chemistry, biochemistry, and physiological functions of the vitamins, with emphasis on nutritional aspects.

605 Forages, Fiber, and the Rumen Spring. 4 credits. Prerequisites: either general nutrition and biochemistry or permission of instructor.
M W F 12:20, F 1:25. P. J. Van Soest.
Ruminant nutrition, lower-tract fermentation in mongastrics, nutritional biochemistry of forage plants, fiber, and cellulosic material.

609 Seminar in Poultry Biology Fall or spring. Limited to graduate students. S-U grades only.
Hours to be arranged. Staff.
A survey of recent literature and research in poultry biology.

610 Seminar Fall and spring. 1 credit. Required of all graduate students with a major or minor in animal science. S-U grades only.
M 11:15. Department faculty.

613 Forage Analysis Spring. 2 credits. Prerequisite: permission of instructor.
Lab, R 2–4. P. J. Van Soest.
Chemical composition and nutritive evaluation of forage plants and related materials. The course includes a term paper summarizing results of independent lab study of either materials or methods.

619 Field of Nutrition Seminar Fall or spring. Noncredit.
M 4:30.
Current research in nutrition is presented by visitors and faculty.

620 Seminar in Animal Breeding Fall or spring. 1 credit. Limited to graduate students with a major or minor in animal breeding. S-U grades only.
Hours to be arranged.

621 Seminar in Reproductive Physiology Fall and spring. 1 credit.
Hours to be arranged. R. H. Foote and staff.
Topics in reproductive physiology and endocrinology are presented by staff, graduate students, postdoctorals, and outside speakers.

640 Special Topics in Animal Science Fall or spring. 1 or more credits.
Hours to be arranged. Staff.
Study of topics in animal science more advanced or different from other courses. Subject matter depends on interests of students and availability of staff.

720 Experimental Methods in Quantitative Genetics and Animal Breeding Spring. 3 credits. Prerequisites: matrix algebra, linear models, and mathematical statistics.
Hours to be arranged. R. L. Quaas.
Estimation of genetic and environmental parameters required to design efficient selection programs. Emphasis is given to interpretation of experimental and survey data with unequal subclass numbers and to prediction of genetic progress resulting from alternative selection methods.

Related Courses in Other Departments

Introductory Animal Physiology (Biological Sciences 314)

Introductory Animal Physiology Laboratory (Biological Sciences 319)

Milk Quality (Food Science 351)

Special Studies on Problems of Livestock Production in the Topics (International Agriculture 602)

Lipids (Nutritional Sciences 602)

Poultry Hygiene and Disease (Veterinary Medicine 255)

Introductory Parasitology and Symbiology (Veterinary Medicine 330)

Medical Parasitology (Veterinary Medicine 331)

Systematics and Bionomics of Animal Parasites (Veterinary Medicine 332)

Health and Diseases of Animals (Veterinary Medicine 475)

Avian Diseases (Veterinary Medicine 555)

Atmospheric Sciences

Courses in atmospheric sciences are offered by the Department of Agronomy. See page 11.

Biological Sciences

See page 134.

Communication Arts

D. F. Schwartz, Chairman; N. E. Awa, R. D. Colle, R. H. Crawford, B. O. Earle, C. H. Freeman, D. A. Grossman, Bruce E. Harding, J. E. Hardy, J. E. Lawrence, R. D. Martin, R. E. Ostman, E. Owens, M. Richards, J. Rowe, T. M. Russo, M. A. Shapiro, R. E. Shew, V. R. Stephen, R. B. Thompson, W. B. Ward, S. A. White, A. M. Wilkinson

150 Writing for Media Fall. 3 credits. Limited to communication arts freshmen and first-year transfer students.
Lec, T 8; disc, W 12:20–2:15 or 2:30–4:25.
M. A. Shapiro.
Basic writing for print and broadcast. A back-to-basics approach to writing for clarity and style, using news and feature writing as a framework. Media form and style are analyzed. Frequent writing assignments, both in and outside of class, are given.

200 Theory of Human Communication Fall or spring. 3 credits. S-U grades optional.
Lecs, T R 12:20; disc to be arranged. Staff.
An introduction to behavioral theories of communication from a multidisciplinary perspective. Contributions from the mass media, anthropology, sociology, psychology, social psychology, rhetoric, and cybernetics are considered.

205 Parliamentary Procedure Fall or spring. 3 credits. Limited to 40 nonfreshman students.
R 1:25–4:25. R. D. Martin.
A study of the principles and practice of parliamentary procedure. Emphasis on practical experience and the importance of a well-run meeting as an integral component of effective communication.

Includes recording of minutes, committee assignments, development of bylaws, and meeting evaluations.

210 Communicating Public Information Fall. 3 credits. For those not majoring in communication arts.
M W F 8. J. E. Lawrence.
Examines concepts, methods, techniques, and processes for communicating information to the general public. Explores use of public service time and space through broadcasting, films, publications, and other channels. Emphasis on basic understanding of media requirements and procedures in disseminating public information. Students design information programs.

215 Introduction to Mass Media Fall or spring. 3 credits. Limited to 190 nonfreshman students. S-U grades optional.
M W F 11:15. R. E. Ostman.
History, policies, philosophies, and practice of communication media. The effect of freedom of the press, ethics, libel, and slander on the day-to-day functioning of the media.

230 Visual Communication Fall. 3 credits. Limited to 100 nonfreshman and communication arts freshman students. Not recommended for art or design majors.
M W F 10:10. V. R. Stephen.
A basic course in the use and importance of visual communication methods and materials in today's society. Posters, charts, displays, photographs, slides, overhead projection, motion pictures, and television are among the topics discussed. Practical projects are assigned.

231 Art of Publication Spring. 3 credits. Each section limited to 30 nonfreshman students. Project materials cost about $20–$40.
M or W 1:25–4:25. V. R. Stephen.
A basic course designed to explore visual concepts that increase communication effectiveness through the printed word. The importance of selecting and coordinating format, layout, typography, and illustrations is stressed. Lectures, a field trip, in-class assignments, and three outside projects examine opportunities and problems in publication design and production.

301 Oral Communication Fall or spring. 3 credits. Each section limited to 24 sophomores, juniors, and seniors.
Discs, M W F 8, 9:05, 10:10, or 11:15; M T W 1:25; M W 9:05 and T 12:20; T R 9:05 and W 12:20; T R 9:05 and W 1:25; T R 10:10 and W 12:20; T R 10:10 and W 1:25; T R 10:10 and W 2:30; T R 11:15 and W 12:20; T R 11:15 and W 1:25 or T R 11:15 and W 2:30. B. O. Earle, R. D. Martin, E. Owens, M. Richards, J. Rowe, T. M. Russo, R. B. Thompson, and staff.
A study of the basic process and principles of oral communication. Through theory and practice, the student is encouraged to develop self-confidence and competence in public speaking. Provides experience in preparing, delivering, and evaluating oral presentations.

302 Persuasion Fall or spring. 3 credits. Prerequisite: Communication Arts 301.
Lecs, M W F 11:15; discs, T R 11:15 or 12:20 or W F 11:15. In weeks discussion sections are held, there is no Wednesday or Friday lecture. B. O. Earle.
The course concentrates on the analysis and understanding of the persuasion events around us. The oral presentations stress the application of various theories of persuasion to the interpersonal communication process.

303 Small Group Communication Fall. 3 credits. Limited to juniors and seniors. Prerequisite: Communication Arts 200 or permission of instructor.
T R 10:10; discs to be arranged. N. E. Awa.
Theory and practice in leadership and participation in small-group communication. The course examines the values and limitations of group discussion, collaborative behavior, and conflicts in a democracy.

311 Radio and Television Communication Fall. 3 credits.
M W F 9:05. R. D. Colle.
An overview of the roles of radio and television in contemporary society, with particular emphasis on the development, organization, and influence of these media in the United States. Attention is also given to the structure and uses of radio and television in other nations, to provide perspective on the systems here, and to the techniques and constraints involved in program production.

[312 Advertising and Promotion Fall or spring. 3 credits. Limited to 190 juniors, seniors, and graduate students. S-U grades optional. Not offered fall 1980.
T 1:25–4:25. R. E. Ostman.
Examines advertising principles and techniques from both a historical and an economic perspective. Advertising and promotion campaigns and their overall effectiveness as a multiplier in the economy are analyzed. Current advertising trends and the strategy of media planning are examined.]

314 Technical and Scientific Writing and Editing Fall or spring. 3 credits. Sections limited to 20 nonfreshman students.
General sections, T R 9:05 and W 11:15, T R 10:10 and W 12:20, or M W F 9:05; biological sciences section, M W F 9:05; engineering and physical sciences section, T R 10:10 and W 12:20. J. E. Hardy, A. M. Wilkinson.
Designed to develop skills in writing and editing scientific and technical information. Emphasis is on clarity, accuracy, and appropriate format. Students interpret scientific and technical information through the study of reports, instructions, brochures, and articles. One writing or editing assignment each week.

315 Basic Newswriting for Newspapers Fall and spring. 3 credits. Limited to 30 students. Prerequisite: major in communication or permission of instructor. Typing ability is essential.
R 1:25–4:25. R. E. Shew, director, News Bureau, Cornell University.
Writing and analyzing news stories. A study of the elements that make news, sources of news, interviewing, writing style and structure, new publishing techniques, press problems, and press-society relations.

316 Scientific Writing for the Mass Media Fall and spring. 3 credits.
Lec, M 9:05; disc, R 10:10–2:35.
Writing on scientific topics in the print and electronic media for a lay audience. Through frequent outside writing assignments, students will communicate complex technical information and issues and will use interviewing and research methods that ensure technical accuracy. Students will be familiarized with the public policy and institutional milieu that have an effect on science writing and will reflect that knowledge in their writing.

318 Radio Writing and Production Spring. 3 credits.
T 1:25–4:25. J. E. Lawrence.
Scripting and recording various public information formats for possible use on local and state radio stations. Students will create complete broadcasting plans and materials for public and private organizations.

319 Television Writing and Production Spring. 3 credits. Limited to 25 students. S-U grades optional.
R 1:25–4:25. R. D. Colle.
Creation of television information programs, from development of idea through research, scripting, and production.

380 Independent Honors Research in Social Science Fall or spring. 1–6 credits. Limited to undergraduates who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.

401 Communication Law Fall. 3 credits. Limited to junior, senior, and graduate majors in communication arts; others by permission of instructor.
M W F 11:15. D. A. Grossman.
A practical survey of the law governing mass media for those working in the field. Coverage includes restraints on news gathering and publication, privacy, defamation, copyright, broadcast licensing, access, and the Fairness Doctrine.

[403 Topics in Communication Theory Fall. 3 credits. Prerequisite: Communication Arts 200 or permission of instructor. Offered alternate years. Not offered 1980–81.
Topics in communication theory, determined by the interest of faculty and students, are discussed.]

[404 Psychology of Communication Spring. 3 credits. Prerequisite: Communication Arts 200 or permission of instructor. Not offered 1980–81.
M W F 9:05. N. E. Awa.
An advanced multidisciplinary study of communication theory. Topics include personal interaction, channels of communication, and effectiveness of message. Study includes intensive analysis of primary sources of major communication theorists.]

413 Writing for Magazines Fall or spring. 3 credits. Limited to juniors, seniors, and graduate students.
M 1:25–4:25. Fall, W. B. Ward; spring, M. A. Shapiro.
Intensive fact writing to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing are studied; magazines in many fields of interest are reviewed. All articles are analyzed and returned to the student to rewrite and submit to a magazine.

420 Print Media Laboratory Fall. 3 credits. Limited to junior, senior, and graduate communication arts majors. Prerequisite: Communication Arts 231, 314, or 413.
R 1:25–4:25. J. E. Hardy, V. R. Stephen.
Writing, editing, and layout principles practiced in publishing the *Cornell Countryman*. Some additional outside work sessions may be required.

421 Broadcast Media Laboratory Fall. 2 credits. Limited to junior and senior communication arts majors. Prerequisite: Communication Arts 318 or 319.
T 1:25–4:25. R. D. Colle.
Emphasis on production of television and radio programs for various audiences.

422 Print Media Laboratory Spring. 3 credits. Limited to junior, senior, and graduate communication arts majors. Prerequisite: Communication Arts 231, 314, or 413.
R 1:25–4:25. J. E. Hardy and V. R. Stephen.
A continuation of Communication Arts 420.

423 Broadcast Media Laboratory Spring. 2 credits.
R 1:25–4:25. J. E. Lawrence.
A continuation of Communication Arts 421.

440 Photo Communication Fall or spring. 3 credits. Limited to 25 junior and senior communication arts majors; others by permission of instructor. For those with limited experience in

photography. Students are expected to furnish their own supplies and cameras. Supplies will cost approximately $40–$50.
T 1:25–4:25. C. H. Freeman.
Basic photography; camera handling, film processing, projection printing, and photographic lighting. Photojournalism emphasized during the latter part of the course.

498 Communication Teaching Experience Fall and spring. 1–3 credits each semester. Limited to juniors and seniors. Intended for undergraduates desiring classroom teaching experience.
Prerequisite: permission of the staff member who will supervise the work and assign the grade.
Hours to be arranged. Staff.
Periodic meetings with the instructor cover realization of course objectives, evaluation of teaching methods, and student feedback. In addition to aiding with the actual instruction, each student will prepare a paper on some aspect of the course.

499 Independent Research Fall or spring. 3–6 credits. Limited to senior and graduate communication arts majors. Seniors must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Staff.
Permits outstanding students to carry out independent studies in communications research under appropriate supervision.

601 Intercultural Communication Spring. 3 credits.
T 1:25–4:25. Bruce E. Harding.
A systematic analysis of sociocultural and psycholinguistic obstacles to effective communication between cultures, subcultures, and ethnic and identity groups. Also examined are the subtleties and complexities of nonverbal behavior in cross-cultural transactions. Examples are drawn from ethnolinguistic and cross-cultural studies.

[612 Seminar: Interpersonal Communication Spring. 3 credits. Not offered 1980–81.
W 1:25–4:25. N. E. Awa.
A study of recent advances and research in leadership, small-group interaction, and communication networks. New developments are examined as they relate to business, administration, and education.]

614 Scientific Writing for Scientists Fall and spring. 3 credits. Prerequisites: a research project in progress and permission of the instructor.
Hours to be arranged. A. M. Wilkinson.
For students with research in progress who wish to write journal articles, theses, reports, and proposals. Workshop, with discussion and lectures on objectives in scientific writing, publication, and review; relation of rhetoric and linguistics to scientific writing; process of publication; preparation of tables and illustrations; advanced and special problems in organization, development, grammatical structure, and usage.

620 Communication in Organizations Fall. 3 credits. Prerequisite: permission of instructor.
W 1:25–4:25. S. A. White.
Review of theories, research, and practical systems as they relate to human communication effectiveness in organizations. Includes components of interpersonal communication, intragroup and intergroup communication, communication factors and organizational goals, skill improvement, and media in organizations — software and hardware, networking, and research methodology.

624 Communication in the Developing Nations Spring. 3 credits. Limited to seniors and graduate students.
M 1:25–4:25. R. H. Crawford.
An examination of existing communication patterns and systems and their contributions to the development process. Attention is given to the interaction between communication development and national development in primarily agrarian societies.

631 Studies in Communication Fall. 3 credits. Limited to graduate students in communication arts; others by permission of instructor.
M 1:25–4:25. N. E. Awa.
A review of classical and contemporary research in communication, including key concepts and areas of investigation. An exploration of the scope of the field and the interrelationships of its various branches.

632 Methods of Communication Research Fall. 3 credits. Limited to graduate students.
T 1:25–4:25. R. E. Ostman.
An analysis of the methods used in communication research. Emphasis is on understanding the rationale for experimental, descriptive (empirical and nonempirical), and historical-critical research methods.

640 Seminar in Organizational Communication Spring. 3 credits. Open to seniors by permission.
W 1:25–4:25. S. A. White, W. Frank.
Communication functions (human and mass media) in organizational structures of business, industry, labor, education, etc., from the perspectives of academic authorities and managers. Development of conceptual schemes for analyzing components of organizational and human communication effectiveness.

643 Frontiers in Communication Fall. 3 credits.
R 1:25–4:25. R. D. Colle.
A study of recent developments in communication. Emphasis is on the strategic application of the new methods, materials, and technology in visual, print, film, oral, and telecommunication media or contemporary and future problems significantly involving communication.

650 Advanced Communication Seminar Spring. 3 credits. Primarily for graduate students but open to seniors.
W 9:05–12:05. R. H. Crawford.
An analysis of special public communication problems faced by different types of organizations, institutions, and companies. Case histories dealing with health, nutrition, and food and agriculture issues, international affairs, government activities, rural development, etc., are used to show how communication programs are organized and executed to help solve problems.

651 Seminar: Communication Issues 0 credit. S-U grades only.
Hours to be arranged. Staff.
The seminar deals with contemporary issues in communication, especially those related to the use of mass media as sources of information and influence, organizational communication, and intercultural communication.

690–691 Communication Teaching Laboratory Fall and spring. 1–3 credits each semester. Limited to graduate students. Prerequisite: permission of the staff member who will supervise the work and assign the grade.
Hours to be arranged.
Designed primarily for graduate students who want experience in teaching communication courses. Students work with an instructor in developing course objectives and philosophy, planning, and teaching.

760 Advanced Communication Projects Fall or spring. 3 credits. Limited to communication arts graduate students. May not be repeated.
Staff.
Independent studies and projects are carried out in conjunction with selected undergraduate courses.

895 Directed Graduate Study Fall or spring. 3–6 credits. S-U grades only.
Staff.

Education

J. P. Bail, chairman; H. G. Andrus, A. L. Berkey, G. J. Broadwell, R. L. Bruce, J. L. Compton, H. R. Cushman, W. E. Drake, J. A. Dunn, J. R. Egner, R. B. Fischer, H. A. Geiselmann, M. D. Glock, D. B. Gowin, E. J. Haller, D. E. Hedlund, J. Millman, D. M. Monk, J. D. Novak, G. J. Posner, R. E. Ripple, V. N. Rockcastle, K. A. Strike, R. W. Tenney, H. L. Wardeberg

110 Introduction to Psychology Fall and spring. 4 credits.
Lecs, M W F 10:10; 1 disc to be arranged.
D. E. Hedlund.
Survey of the major areas of psychological inquiry with emphasis on the personal application of psychological knowledge to the problems of living and to current social issues, including how to be an intelligent consumer of psychological research.

240 The Art of Teaching Spring. 3 credits.
T R 1:25–2:40. G. J. Posner.
This course is designed for all students interested in finding out more about teaching. Teaching is considered an activity in which people of many occupations engage, not limited to schools. Students engage in field experiences to find out what teaching involves (minimum of 1½ hours a week). Class work builds on this experience and provides skills and concepts to make the field experience more profitable.

311 Educational Psychology Fall or spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
Fall, M W F 11:15; R. E. Ripple. Spring, M W F 9:05; M. D. Glock.
An introductory survey course. Emphasis is on human learning and the educational process from a psychological point of view. The course is set in a broadly based teaching-learning context appropriate for prospective teachers, youth group leaders, community leaders, and those in the service-helping professions.

312 Learning to Learn Spring. 3 credits. Prerequisite: one or more courses in psychology or educational psychology.
T R 2:30. J. D. Novak.
This course is intended for persons interested in the improvement of educational programs through the application of new knowledge in learning theory. Lectures and discussions are based on assigned readings and the contributions of class members. The learning theory of David Ausubel is presented in some detail. The major focus of the course is how and why concepts play a central role in human learning.

317 Psychology of Adolescence Spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
T R 1:25–2:40. R. E. Ripple.
A survey of the nature of adolescent development, with emphasis on causal factors of adolescent behavior. Focus is on an examination of the interrelationships among the major aspects of adolescent development, an examination of some of the dominant themes of adolescence, acquaintance with research on adolescent development, and implications for the educational process.

331 Introduction to Teaching Agriculture Spring. 2 credits. Required of persons who plan to enter the student teaching program.
Lec, M 1:25–3; lab to be arranged. W. E. Drake.
An introduction to the origin, development of curricula, and methods of teaching agriculture in secondary schools. Purposes are (1) to provide exploratory experience in teaching agriculture and (2) to prepare prospective teachers for participation in the resident student teaching program leading to teacher certification.

335 Youth Organizations Spring. 3 credits. Prerequisite: introductory psychology.
Lecs, T R 10:10; lab to be arranged. R. W. Tenney.
The role of selected youth organizations in providing educational experiences for youth. Factors affecting membership, purposes, design, operation, and administration are surveyed with emphasis on the roles the adult volunteer leader may play. The course is designed to give the student an in-depth, learning-by-doing experience of how youth organizations function. Field experience with a recognized youth organization is required.

340 Theories of Teaching Fall. 3 credits.
M W 2:30–3:45. G. J. Posner, K. A. Strike.
This course is intended to assist the student in conceptualizing the process and contexts of teaching in school and nonschool settings. The course examines representative theories of teaching and provides an opportunity for students to develop their own views.

352 Reading Statistics Fall or spring. 1 credit. Prerequisite for spring: concurrent registration in Education 353.
Fall, T 12:20; spring, T R 8:30–9. J. Millman.
An introduction to statistical vocabulary and symbolism frequently used in reporting empirical research in education and other social sciences. Students are taught how to comprehend statistical terminology and results.

353 Introduction to Educational Statistics Spring. 3 credits. Prerequisite: Education 352 or concurrent registration in Education 352, or permission of instructor.
T R 9:05–11. J. Millman.
A study of common statistical procedures encountered in educational inquiry. Includes the mathematical bases, computation, and interpretation of univariate and multivariate descriptive and inferential statistics.

370 Issues in Educational Policy Spring. 3 credits.
M W F 10:10. K. A. Strike.
An examination of the social, political, and economic issues that affect teaching and learning in schools and other settings. Included are such issues as educational opportunity, governance and policymaking, school and community, the economics of education, and the teacher in a social context.

371 Sociology of Education Spring. 3 credits. S-U grades optional.
T R 10:10–11:30. E. J. Haller.
An introduction to the sociological study of schooling and education. Topics include the effects of social factors on educational achievement, the norms and values learned as part of the process of schooling, the relations between students and teachers, and the school's functions in the economic and political systems. All levels of education, from elementary school to the university, are considered.

380 Independent Honors Research in Social Science Fall or spring. 1–6 credits. Limited to students who have met requirements for the honors program. S-U grades optional. A maximum of 6 credits may be earned in the honors program.
Staff.

400 Field Experience Fall or spring. 1–4 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
Students may engage in planned semiprofessional or professional practice in an educational enterprise. Each student prepares a plan of action including rationale, purposes, and procedures and arranges with a faculty member to supervise and evaluate the field experience.

401 Our Physical Environment Fall or spring. 3 credits. Prerequisite: permission of instructor. Charge for lab supplies, approximately $7.
T 1:25–4:25. V. N. Rockcastle.
A practical, relatively nonmathematical study of some basic relationships and physical interactions in the environment, with emphasis on physics and earth science. Attention is paid to analysis for understanding and techniques for teaching. A two-week session on photography and an individual research project are included. Useful for teachers and environmental educators.

403 Environmental and Natural History Writing Spring. 3 credits. Limited to upperclass and graduate students. Prerequisites: a course in composition, working knowledge of biology and ecology, permission of instructor.
W 7–9:45 p.m. R. B. Fischer.
For those who want to develop skills in changing environmental attitudes and behavior using newspapers, magazines, and radio. The class produces a weekly environmental awareness column for a local newspaper and records scripts for a weekly radio program.

404–405 Field Natural History Fall and spring. 3 credits each semester. Limited to upperclass and graduate students. Prerequisites: basic biology and ecology and permission of instructor. 404 not prerequisite to 405.
Fall: lec, M 10:10; labs, M R 1:25–4:30. Spring: lec, M 10:10; lab M 1:25–4:30. R. B. Fischer.
This course provides students who plan to be professional environmental interpreters and educators with methods and materials for sensitizing people about the complexity and fragility of their living environment. It produces practical experiences in teaching about the environment in a variety of classroom and out-of-classroom settings.

407 Teaching Elementary Science Fall. 3 credits.
W 1:25–4:25. V. N. Rockcastle.
An analysis and synthesis of science concepts and related behaviors for children and young adults, with emphasis on sequencing and instruction in school and environmental centers. Includes practical experiences in local schools and youth centers.

411 Educational Measurement Fall. 3 credits. Prerequisite: permission of instructor.
T 2:30–4:30, 1 additional hour to be arranged.
M. D. Glock.
Construction of achievement tests and use of other measuring instruments in the classification and guidance of pupils for improvement of instruction. Opportunities are given to construct tests and evaluate standardized instruments. Emphasis is on the use of formal and informal instruments by the classroom teacher.

413 Psychology of Human Interaction Fall. 3 credits. Fee, $5.
T R 10:10–12:05. D. E. Hedlund.
Designed to develop skills for and understanding of effective interpersonal communication and interaction. The course is largely experiential, utilizing audio and video recordings in laboratory sessions. Students should have access to a cassette recorder.

[414 Counseling Psychology Spring. 4 credits. Limited to 30 students. Prerequisites: introductory psychology, social or personality psychology, and Education 413. Not offered 1980–81.
T R 10:10–12:05. D. E. Hedlund.
The processes of counseling are examined from the perspectives of behavioral psychology and humanistic psychology. Research on adult development, college-age and on, is reviewed, and typical adult counseling issues are examined. Implications are drawn for counseling strategy with an adult population, including psychological assessment, establishing therapeutic goals, intervention strategies, and evaluation of outcomes. Alternative models of service delivery such as outreach, consultation, and psychoeducation are emphasized.]

430 (433) Special Problems in Agricultural Education Fall, spring, and summer. 1–3 credits. S-U grades optional.
Fall: R 1:25. Spring: F hours to be arranged.
R. W. Tenney.
An opportunity to study individually selected problems in agricultural education.

432 Teaching Agriculture: Methods, Materials, Practice Fall. 9 credits. Prerequisite: Education 331. Education 434 may be taken concurrently.
M T W R F 8–3. A. L. Berkey and staff.
Directed participation in teaching agriculture at the secondary school level. Program includes an intensive four-week on-campus period where methods and materials of teaching agriculture are treated in detail, combined with a ten-week period in a student teaching center. Includes evaluation of area resources, instructional materials and facilities, development of curricula, directing work experience, planning instruction, and advising youth organizations.

434 Adult Education Programs in Agriculture Fall. 3 credits. Prerequisite: concurrent registration in Education 432.
Lec to be arranged. H. R. Cushman.
Determining instructional needs, planning programs of instruction, teaching in groups, giving on-the-job instruction, and evaluating adult education programs in agriculture.

435 Educating for Community Action Spring. 3 credits.
T R 10:10–12:05. R. L. Bruce.
The design and execution of educational aspects of community action programs. Deals with the identification and statement of educational goals, selection of teaching strategies, and evaluation of outcomes.

445 Curriculum Design Fall. 3 credits. Education 545 may be taken concurrently.
T R 10:10–11:30. G. J. Posner.
A general practical approach to course planning. Readings, group discussions, workshops, and individual conferences centering on each student's project. This project consists of designing a course in a subject area, for an age level and an institutional setting of the student's choosing.

446 Implementing Instruction Spring. 2 credits.
Lec-lab, W 1:25–4:25. V. N. Rockcastle.
A study of the elements of effective instruction in the lecture, laboratory, seminar, field trip, and other modes of instruction. Practice in developing and presenting various modes of instruction, with critiques by the class.

472 Philosophy of Education Fall. 3 credits.
T 2:30–4:25. K. A. Strike.
A study of central issues in the philosophy of education. Questions of ethics, political philosophy, and the theory of knowledge are examined, and the implications for education assessed.

473 Contemporary Philosophy of Education Spring. 3 credits.
M W 11:15; disc, 1 hour to be arranged.
D. B. Gowin.
The topic is value concepts. Issues of value in education (values clarification, behavior modification, moral development) are treated philosophically by drawing on normative concepts of value (e.g., self-interest, utility, freedom, rights and duties, justice) from ethics and social philosophy. A theory of value for education is discussed.

477 Law and Educational Policy Spring. 3 credits. Offered alternate years.
T 2:30–4:30. K. A. Strike.
A study of recent federal court decisions concerning education. Emphasis on examining legal issues against a background of related educational theory and in terms of the consequences of legal decisions for the development and operation of educational institutions.

478 Economics of Education Fall. 3 credits.
T R 12:20–1:50. D. H. Monk.
An introduction to the use of economic principles to study education and educational policy. Specific attention is given to the impact of education on economic growth, the distribution of earnings, and characteristics of the labor force. The concept of human capital is introduced and developed as a means of understanding these phenomena. Techniques of cost-benefit and cost-effectiveness analysis are used to shed light on current controversies regarding the effectiveness of alternate types of schooling. No formal training in economics is presupposed.

497 (500) Independent Study Fall or spring. 1–3 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
A student may, with approval of a faculty adviser, study a problem or topic not covered in a regular course or may undertake tutorial study of an independent nature in an area of educational interest.

511 Educational Psychology Fall. 3 credits. Prerequisite: introductory psychology. S-U grades optional.
M W F 1:25. R. E. Ripple.
A basic survey course for graduate students. Emphasis on psychological factors involved in human learning and the educational process. Set in a broad-based conceptual model of any behavioral setting for learning. Appropriate for those seeking an introduction to educational psychology or a refresher course in contemporary educational psychology.

512 Standardized Tests: Use and Interpretation Fall. 3 credits.
R 3:35–5:15, 1 additional hour to be arranged.
H. G. Andrus.
For teachers, counselors, or personnel majors who plan to work with standardized tests.

513 A Theory of Education Fall. 3 credits. Prerequisite: Education 311 or 511, or permission of instructor.
T R 9:05. J. D. Novak.
Presents a coherent theory of education combining concepts from philosophy, psychology of learning, curriculum, and instruction. Classes include discussion of student-initiated questions. Students are assisted in applying theory to their own discipline.

[514 Group Processes in Education Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. Not offered 1980–81.
T R 10:10–12:20. D. E. Hedlund.
Consideration of effective group membership and leadership, with emphasis on the theory and practice of facilitating small-group processes. Included are the design and evaluation of structured group exercises for the classroom, the use of groups in counseling, and an examination of the consulting role as an educational strategy.]

[515 Affective Education Spring. 3 credits. Prerequisite: permission of instructor. Not offered 1980–81.
M W 1:25–3:30. D. E. Hedlund.
This course examines the conceptual base and the methodology of teaching for objectives in the affective realm. The first part of the semester is devoted to the intrapersonal dynamics of individual development and the relationship of affective and cognitive learning. The second part focuses on the interactive nature of the teaching-learning transaction and the effective use of small-group dynamics in teaching. The capability to design teaching-learning experiences that incorporate affective objectives is a major goal. The course is largely experiential, providing participation in a variety of approaches to affective education.]

519 Methods of Educational Inquiry Fall. 3 credits. Prerequisite: statistics, Education 352, or concurrent registration in Education 352.
T R 2:30–4. J. Millman.
Techniques of empirical research in education, including design of experiments and methods of data collection. Provides an opportunity for students to write a research proposal and for small groups to conduct a ministudy. Students are taught how to plan and conduct an empirical research study and how to critique the work of others.

535 Continuing Education Programs Spring. 3 credits. Prerequisite: some work experience.
W 1:20–4. G. J. Broadwell.
An overview of selected theories, principles, and strategies applicable to management of decentralized, professionally staffed nonformal educational organizations and change agencies. Content includes management functions, managerial leadership, management by objectives, and decision-making strategies. Particular attention is given to leadership of organizations with volunteer staff.

543 Structure of Knowledge and Curriculum Spring. 3 credits. Prerequisite: permission of instructor.
M W 12:20–2:10. D. B. Gowin.
A method for the critical analysis of knowledge and value claims embedded in primary sources is presented. Students use this method of analysis on materials chosen according to their own background or interest. Students develop their materials to the point where they could be used for instructional purposes. A special theory of curriculum developed by the instructor is presented.

[544 Teaching Mathematics Spring. 3 credits. Not offered 1980–81.
T R 2:30–3:45. H. A. Geiselmann.
Intended to provide competence in presenting mathematics using various approaches — discovery, audiovisual aids, laboratory techniques, individualized instruction, use of games, puzzles; acquaintance with teaching resources; geometrical constructions; discussion of the slow learner. Each student selects a project and presents it to the class.]

545 Curriculum Theory and Analysis Fall. 3 credits. Prerequisite: Education 311 or 511, concurrent registration in Education 511, or permission of instructor.
M W 10:10–11:30. G. J. Posner.
An examination of the basic elements involved in making curriculum decisions and an analysis of current approaches to curriculum. Students learn to analyze a curriculum in the context of a conceptual framework. This course is the basic graduate course in curriculum.

546 Evaluation for Program Management Spring. 3 credits. S-U grades optional.
M 2:30–5. R. L. Bruce.
Primary attention is given to educational and other community change programs, but inferences to other program management tasks are made.

561 Administration of Educational Organizations Fall. 3 credits.
W 3:35–6. E. J. Haller.
Perspectives on the administration of educational organizations. Consideration of classic and contemporary organization theories and their application to both public and higher education. Intended for students who are considering careers as educational administrators as well as for those who want to further their understanding of schools as organizations.

[562 Ethical Issues in Educational Administration Spring. 3 credits. Offered alternate years. Not offered 1980–81; next offered 1981–82.
T 2:30–4:30. E. J. Haller, K. A. Strike.
This course deals with the identification and conceptualization of ethical problems likely to arise in administering an educational organization. Typical problems concern rights of parents, teachers, and students, equity and due process in hiring, retention and promotion, and race relations. The course integrates case studies with appropriate philosophical literature.]

[563 Governance of Public Education Fall. 3 credits. Offered alternate years. Not offered 1980–81.
W 3:35–6. E. J. Haller.
Consideration of the structure of control in public education. Relationships among federal, state, and local agencies and the administrative roles in school districts. Considerable attention is directed to social and political analyses of the community.]

564 Educational Finance Fall. 3 credits. S-U grades optional.
W 9–11. D. H. Monk.
Attention is focused on tasks and procedures involved in budgeting, support systems, allocation, control, accountability, and the measurement and reporting of benefits and productivity. An opportunity for individuals to focus on their own areas of interest, such as occupational education, the two-year college, the secondary school, or higher education.

565 Systems Analysis in Educational Administration Spring. 3 credits. S-U grades optional.
W 9:05–11, plus one hour to be arranged.
D. H. Monk.
An exploration of the usefulness of economic tools of analysis in the study of educational productivity and the management of educational systems. Topics will include the impact of state and federal policy on the internal operation of educational organizations, programming approaches to budgeting and scheduling, collective bargaining and the compensation of personnel, input-output analysis of productivity, resource allocation in classrooms, and the economics of instruction. No previous training in economics is assumed.

[569 Personnel Development: Issues in Higher Education Spring. 3 credits. Not offered 1980–81.
R 3:35–6. H. L. Wardeberg.
An examination of selected issues that affect the administration and development of academic and nonacademic personnel in continuing and higher education institutions.]

574 History of American Education Fall. 3 credits.
M 3:35–5:15. Instructor to be announced.
An examination of American schools, colleges, and other educative agencies from colonial beginnings to the present. An attempt is made to view education in the context of the evolution of American norms and values.

575 Educational Policy Development and Decision Making Fall. 3 credits. S-U grades optional.
R 3:35–5:30. E. J. Haller.
This course provides an introduction to the policymaking process in and around the educational institution. After a consideration of the nature of public policy, topics included are governmental responsiveness, power and influence in policymaking, political parties and interest groups, and administration as policymaking. The class is

organized as a seminar. Each student prepares and presents a paper relevant to one of the topics considered.

600 Internship in Education Fall or spring. 2–6 credits. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for supervising the work.
Staff.
An opportunity for practical experience in educational professions development.

601 Research Seminar Fall and spring. 0 credits.
M 4–5:30.
Presentation of current research in the field of education by graduate students and staff. Opportunities to discuss methodology, findings, and other aspects of research.

602 Proseminar in Organization and Management of Sponsored Research Fall and spring. 2 credits each term. S-U grades optional. Prerequisite: permission of instructor.
F 2:30–4. J. A. Dunn.
Designed for doctoral students, advanced graduate students, and practitioners in the field who have responsibility for the promotion, management, or supervision of educational research, development, or evaluation projects. The seminar is devoted to an in-depth review of the history of educational research, patterns of federal support, the federal procurement process, and proposal preparation. Successful and unsuccessful proposals are analyzed. Attention is given to alternative strategies for proposal development.

606 Seminar in Science and Environmental Education Fall or spring. 1 credit.
T 7:30–9:30 p.m. R. B. Fischer, V. N. Rockcastle.
Coordinates various interest groups in science and environmental education. Discussions center around curriculum development, research and thesis writing, and current problems.

611 Seminar in Educational Psychology and Curriculum Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years.
Hours to be arranged. R. E. Ripple.
Selected aspects of the relationship between curriculum and the psychology of education. Emphasis is on the psychology of human learning and implications for structuring learning experiences and curriculum development. Appropriate for graduate students in educational psychology, curriculum, and instruction and others with interests in the relationship between psychology and curriculum.

615 Seminar in Counseling Psychology Fall or spring. Variable credit. S-U grades only.
W 1:25–3:30. D. E. Hedlund.
Selected topics in counseling psychology to be announced.

618 Adult Learning and Development Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years.
Hours to be arranged. R. E. Ripple.
Deals with adult development and learning behavior from points of view of educational psychology, social psychology, and sociology. Inferences are drawn from theory and research to the practice of adult continuing education. Appropriate for graduate students in educational psychology, extension and continuing education, community service education, and others interested in adult learning and development.

619 Conceptual Problems in Educational Inquiry Fall. 3 credits. Prerequisite: experience or course work in research. S-U grades optional.
R 12:20–2:20. D. B. Gowin.
Techniques and procedures for the critical appraisal of research documents. Practice in such appraisal is required, with primary emphasis on conceptual structures rather than research techniques. Students may use their own research proposals or research products as material for analysis.

624 Designing Extension and Continuing Education Programs Fall. 3 credits. Prerequisite: permission of instructor.
T 1:25–4. Staff.
Designed to help students understand current theories, concepts, principles, and procedures central to the process of developing programs and curricula for the continuing education of adults. Emphasis is on such key problems as conceptualization of the nature and role of programming, situation analysis and needs identification, choosing among alternative courses of action, stating program objectives, macroplanning and microplanning, and program organization.

627 Behavioral Change in International Rural Modernization Spring. 3 credits. For students who have interests or experience in international rural or community development.
J. L. Compton.
An exploration of the social psychological aspects of socioeconomic development, focusing on the theoretical orientations of individual modernity, values-beliefs-motives, achievement motivation, entrepreneurship, innovativeness, expectancies, and self-efficacy and the applied orientations of communication-diffusion of innovation-adoption behavior, nonformal education, community development, planned change, and change agentry.

628 Community Education Fall. 3 credits. For students who have interest or experience in education or development programs where community is an important concern.
W 2:30–5. J. L. Compton.
An examination of the concept of community, changes in community life, the analysis of community, alternative strategies for community development, patterns of response to community by such public institutions as community colleges, cooperative extension, social work, and community schools, and such functional dimensions of community education programming as participatory decision making, paraprofessionals, volunteers, leadership development, council formation and function, interagency coordination, and change agent roles.

629 Comparative Extension Education Spring. 3 credits. Prerequisite: Education 627 or permission of instructor.
R 1:25–4:25. J. L. Compton.
Extension education in the developing nations will be studied using, as an analytical frame of reference, a hypothetical model comprised of such components as community organization, community-based learning, indigenous facilitators and leaders, entension generalists and specialists, residential training, and research-training linkages. Case materials on alternative extension models and intercounty experiences will provide an empirical base.

630 Special Problems in Agricultural and Occupational Education Fall and spring; may also be offered in Summer Session. 1–3 credits. S-U grades optional.
Hours to be arranged. R. W. Tenney and staff.
The course provides an opportunity for graduate-level study of individually selected problems and issues in agricultural and occupational education. Designed for experienced teachers.

632 Teaching Agricultural and Occupational Education Spring. 3 credits. Prerequisite: an introductory course in teaching methods or permission of instructor.
M 2:30–5. A. L. Berkey.
The focus of the course is on the selection, use, and evaluation of methods and materials for teaching occupational subjects. Methods for both group and laboratory instruction are covered. Opportunity is provided through use of modules for students to develop teaching competencies based on their individual needs and interests. Development of self-evaluation skills is included. A class project on the selection or development of instructional materials is required.

633 Curriculum in Agricultural and Occupational Education Fall. 3 credits.
M 1:25–3:30; labs to be arranged. W. E. Drake.
Current situations affecting occupational education curricula are examined. Principles, objectives, and sources of information are developed for planning curricula. Strategies for developing occupational courses are examined. Consideration is given to planning, developing, and managing work experience programs. Participants have an opportunity to observe ongoing programs at the secondary and two-year-college levels and pursue individual interests in curriculum improvement.

634 Adult Education Programs: Organization and Direction Fall. 3 credits.
F 1:25–4:20. H. R. Cushman.
Alternative procedural models for organizing and conducting adult occupational education courses are presented. Guidelines and procedures for implementing the models in secondary and postsecondary school settings are emphasized.

635 Teacher Preparation in Agriculture Fall. 3 credits. Prerequisite: teaching experience in agriculture.
W 1:25–3:20. A. L. Berkey.
For persons with teaching experience interested in the preparation of occupational teachers. Involvement in the Cornell program of teacher preparation in agriculture is expected.

636 Occupational Education Program: Administration and Supervision Spring. 3 credits.
W 2:30–4:25; special sessions to be arranged.
J. P. Bail.
Practices and procedures of organizing, administering, and supervising programs of occupational education at the secondary and postsecondary level are stressed. The role of the director in providing leadership in improving instruction, designing programs, and using resources at federal, state, and local levels is considered.

639 Evaluating Programs in Occupational Education Spring. 3 credits.
T 1:25–3:20; labs to be arranged. W. E. Drake.
This course examines objectives, criteria, and strategies for evaluating programs of occupational education in secondary and postsecondary schools. Evaluation models, case studies, and evaluation as a function of program planning are considered. Participants examine the roles of supervision in evaluation and have an opportunity to develop and apply evaluative instruments. Field trips and resource persons provide opportunities to observe actual evaluation problems and procedures.

645 Seminar in Curriculum Theory and Research Spring. 3 credits. Prerequisite: Education 445 or 545 or permission of instructor.
Hours to be arranged. G. J. Posner.
Theoretical issues in curriculum and appropriate areas for curriculum research are discussed.

669 Studies in Educational Administration Spring. 3 credits. S-U grades only.
W 3:35–6. E. J. Haller.
An analysis and critique of current research in educational administration. Discussion of research priorities and strategies in the conceptual area of educational governance. For graduate students interested in conduct of research on problems of educational governance.

673 Seminar in Dewey's Philosophy of Education Fall. 3 credits. Prerequisite: work in philosophy and permission of instructor. S-U grades optional.
R 3–5. D. B. Gowin.
A detailed analysis of some selected major Dewey works *(Democracy and Education, Experience and Education, Art as Experience).* One objective of the seminar is to help students learn how to read Dewey and to compare and apply his ideas about education to current problems and issues.

[678 Economics of Rural Education Spring. 3 credits. Prerequisite: Education 478 or permission of instructor. Offered in alternate years. Not offered 1980–81.
T R 12:20–1:50. D. H. Monk.
The application of economics to the analysis of current issues concerning manpower planning and human capital development and utilization in rural areas. The course concentrates on the case of rural education in developing as well as industrialized nations. Attention is given to both formal and nonformal types of education.]

679 Economics of Higher Education Spring. 3 credits. Prerequisite: Education 478 or permission of instructor. Offered in alternate years.
T R 12:20–1:50. D. H. Monk.
Applications of economics to the study of the planning, financing, and administration of higher educational organizations. Topics include a critical assessment of current approaches to macrolevel planning as well as the analysis of special problems associated with the financing and administration of particular types of colleges and universities.

711 Seminar in Educational Psychology Fall. 3 credits. Prerequisite: permission of instructor before first meeting. S-U grades optional.
W 4:30–6:30. M. D. Glock.
The seminar has varied emphasis from year to year, focusing on theoretical issues in the teaching, measurement, and evaluation of reading.

716 Seminar in Educational Research and Evaluation Fall or spring. 3 credits. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged. J. Millman.
An intensive study of the literature in a particular area of research methodology. Topics in recent years have included procedures and issues in educational evaluation, the interface of instruction and measurement, and the design of educational experiments. Current topic to be announced.

730 Seminar in Agricultural and Occupational Education Spring. 2 credits. S-U grades optional.
R 2:30–4:25. Staff.
For master's degree candidates who have had teaching experience and doctoral candidates with majors or minors in agricultural and occupational education. Emphasis is on current problems and research and includes discussion of student research proposals.

771 Seminar in the Sociology of Education Fall. 3 credits. S-U grades optional.
Hours to be arranged. E. J. Haller.
Intensive study of a selected topic in the sociology of education, with consideration of its organizational and policy implications.

772 Seminar in Philosophy of Education Spring. 3 credits. S-U grades optional. Prerequisite: permission of instructor.
Hours to be arranged. K. A. Strike.
Topics to be announced.

800 Master's Level Thesis Research Fall or spring. Credit arranged. S-U grades optional. Each registration must be approved by a faculty member who will assume responsibility for guiding the work.
Staff.
Limited to students working on theses or other research and development projects.

900 Doctoral Level Thesis Research Fall or spring. Credit to be arranged. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work.
Staff.
Limited to students working on theses or other research and development projects.

Related Course in Another Department

Historical Roots of Modern Psychology (Psychology 490)

Entomology

E. H. Smith, chairman; W. L. Brown, Jr., E. W. Cupp, J. E. Dewey, G. C. Eickwort, P. P. Feeny, J. G. Franclemont, emeritus, G. G. Gyrisco, H. H. Hagedorn, R. G. Helgesen, W. T. Johnson, J. P. Kramer, R. A. Morse, A. A. Muka, L. L. Pechuman, B. L. Peckarsky, D. Pimentel, E. M. Raffensperger, R. B. Root, A. Sawyer, E. T. Schmidtmann, M. Semel, M. J. Tauber, W. M. Tingey, Q. D. Wheeler, C. F. Wilkinson, R. G. Young

Courses by Subject

Apiculture: 260, 262, 264
Behavior: 662
Ecology: 370, 455, 457, 471, 664, 672, 695
Introductory courses: 200, 212
Medical entomology and pathology: 452, 453
Morphology: 322
Pest management: 241, 342, 440, 443, 640, 677
Physiology and toxicology: 483, 685, 687, 690
Taxonomy, araneology, and acarology: 331, 621, 631, 632, 633, 634, 635

200 Insects and Man Fall. 2 credits. S-U grades optional. Intended for students in all colleges.
Lecs, T R 11:15. E. M. Raffensperger.
A presentation of the insects, with attention to their roles in nature and in civilization. Biological, historical, social, economic, and cultural aspects are discussed.

212 Insect Biology Fall. 3 credits. Prerequisite: Biological Sciences 101–102 (may be taken concurrently) or equivalent.
Lecs, W F 11:15; lab, M T W R or F 2–4:25.
G. C. Eickwort.
Introduces the science of entomology by focusing on basic principles of systematics, morphology, physiology, behavior, and ecology of insects. The lab in early fall includes field trips to collect and study insects in the natural environment. A small collection stressing ecological categories is required.

241 Applied Entomology Spring. 3 credits. Prerequisite: Biological Sciences 101–102 or equivalent.
Lecs, T R 10:10; lab, M T W R or F 2–4:25.
E. M. Raffensperger.
A compendium of the insects associated with crops and farm animals. Discussions of insect pest management requirements on farm and garden, along with descriptions of control methods, materials, and equipment.

260 Introductory Beekeeping Fall. 2 credits.
T R 11:15. R. A. Morse.
Introduces the fundamentals of beekeeping, including the life history, instincts, and general behavior of honey bees. Attention is given to the biology of the honey bee. Some lectures are devoted to pollination of agricultural crops and the production of honey and beeswax.

262 Communication and Social Behavior of the Honey Bees Fall. 1 credit. Limited to 10 students. Prerequisite: permission of instructor.
S afternoon or weekend laboratories to be arranged; evening seminar-lecture to be arranged.
R. A. Morse.
Intended for those interested in the honey bee society as a system for the study of social behavior. Participants will present topics they are interested in. Laboratories will allow direct observation of living bees and introduce some important research techniques. The need for fair weather requires that laboratory scheduling be flexible.

264 Practical Beekeeping Fall. 1 credit. Limited to 20 students. Prerequisite: Entomology 260 (may be taken concurrently).
Lab, R or F 2–4:25. R. A. Morse.
Fourteen labs to acquaint students with practical methods of colony management. Labs involve actual work with package bees and mature colonies. Three labs are concerned with apple pollination and methods of moving colonies into orchards.

[322 Insect Morphology Fall. 5 credits. Prerequisite: Entomology 212 or 241. Offered alternate years. Not offered 1980–81.
Lecs, M W F 10:10; labs, M F or T R 1:25–4:25.
G. C. Eickwort.
An introduction to the external and internal anatomy of insects, with emphasis on the comparative and functional aspects. The lab is devoted largely to dissection.]

331 Introductory Insect Taxonomy Spring. 3 credits. Prerequisite: Entomology 212.
Lecs, R 10:10; labs, T R 2–4:25. Field trips are taken in the late spring. Q. D. Wheeler.
An introduction to the systematics and distribution of insects. Lab practice in the identification of orders, families, and representative genera of insects; methods of collection and preparation of insect specimens.

342 Special Topics in Economic Entomology
Hours to be arranged. Staff.
Topics to be announced.

370 Pesticides in the Environment Fall. 2 credits. Prerequisites: Biological Sciences 101–102 or equivalent.
Lecs, T R 9:05. R. J. Kuhr.
A survey of the different types of pesticides, their uses, their distribution in the environment, and their effects on various components of the environment. For students whose main emphasis is not in pesticide usage.

440 Insect Pest Management Spring. 4 credits. Prerequisites: Entromology 212 or 241, and Entomology 400 or Biological Sciences 360, or permission of instructor.
Lecs, M W F 9:05; lab, M 1:25–4. R. G. Helgesen.
A lecture and lab introduction to principles and techniques of insect pest management as these relate to the diverse problems in contemporary economic entomology.

443 Pathology and Entomology of Trees and Shrubs (also Plant Pathology 443)
See Plant Pathology 443 for course description.

452 Medical Entomology Fall. 3 credits. Prerequisites: either Entomology 212 and Veterinary Medicine 330 or permission of instructor.
Lecs, T R 10:10; lab, R 1:25–4:25. E. W. Cupp.
A survey of arthropods of public health and veterinary importance, with emphasis on transmission dynamics of pathogens, the bionomics of vector populations, and current control concepts. Morphology and taxonomy of selected groups are examined in the laboratory, with additional exercises in vector-pathogen relationships and epidemiological techniques.

453 Insect Pathology Spring. 4 credits. Prerequisites: Entomology 212 or equivalent, a course in microbiology, or permission of instructor.
Lecs, M W 10:10; lab, R 1:25–4:25. J. P. Kramer.
A survey of the diseases of insects caused by viruses, bacteria, fungi, and protozoans and a consideration of the role of microbial diseases in natural and applied insect control. Lab investigations center around living insect — pathogen associations and the consequences of these associations for both insect and microbe.

[455 Insect Ecology, Lectures (also Biological Sciences 455) Fall. 2 credits. Prerequisites: Biological Sciences 360 and Entomology 212, or their equivalents. Recommended: concurrent enrollment in Biological Sciences 457. Offered alternate years. Not offered 1980–81.
Lecs, W F 11:15. R. B. Root.
Ecological and evolutionary principles are integrated by thorough examination of outstanding investigations. Topics discussed include the factors responsible for the great diversity of insects, adaptive syndromes associated with climate, natural history of arthropod guilds, impact of insects on terrestrial vegetation, population regulation, and the contrast between natural and managed ecosystems.]

[457 Insect Ecology, Laboratory (also Biological Sciences 457) Fall. 2 credits. Limited to 16 students. Prerequisite: concurrent enrollment in Biological Sciences 455. Offered alternate years. Not offered 1980–81.
Lab, W 1:25–4:25; F or S field trips to be arranged during the field season. R. B. Root.
Field exercises focus on insect natural history and methods of sampling populations. Laboratories devoted to rearing insects, estimating life-table parameters, and analyzing communities.]

471 Ecology and Systematics of Freshwater Invertebrates Spring. 4 credits. Prerequisite: Entomology 212. Recommended: Biological Sciences 360–462–464.
Lecs, T R 9:05; labs, M W or T R 1:25–4:25.
B. L. Peckarsky.
The lecture explores the life histories, behavior, feeding ecology, and limitations to distributions of macroscopic freshwater invertebrates with an emphasis on insects. The laboratory involves field collections and laboratory identification of invertebrates stressing the use of keys. Students may elect to conduct ecological field projects, or to study the systematics of freshwater invertebrates in more depth.

483 Insect Physiology Spring. 4 credits. Prerequisite: Entromology 212 and a course in biochemistry.
Lecs, M W F 11:15; lab, W or F 1:25.
H. H. Hagedorn.
An introduction to insect physiology, with emphasis on development and organ systems.

497 Special Topics for Undergraduates Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work.
Staff.

499 Undergraduate Research Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work.
Staff.

618 Techniques of Biological Literature Fall. 2 credits. Offered alternate years.
Lecs, T R 9:05. J. G. Franclemont.
The history of the development of entomological literature and a critical study of the biologists' works of reference. Practice in the use of indexes and use and preparation of bibliographies.

[621 Acarology Fall. 4 credits. Prerequisites: Entomology 212 and permission of instructor. Offered alternate years. Not offered 1980–81.
Lecs, M F 10:10; labs, M F 1:25–4:25.
G. C. Eickwort.
An introduction to the taxonomy, morphology, and bionomics of mites and ticks, with emphasis on taxa of economic importance. A collection is required.]

[631 Taxonomy of the Smaller Orders of Insects Fall. 3 credits. Prerequisite: Entomology 331. Offered alternate years. Not offered 1980–81.
Disc, F 10:10; labs, F 2–4:25 and 1 other by arrangement. W. L. Brown.
Discussions of the classification, evolution, and bionomics of the orders and families of insects, excluding the larger orders of Holometabola. Lab studies on the literature and on the characters and classification of representative genera and species. Continuation of taxonomy of Holometabola is in Entomology 632, 633, and 634.]

[632 Taxonomy of the Immature Stages of Holometabola Fall. 3 credits. Prerequisite: Entomology 631 or permission of instructor. Offered alternate years. Not offered 1980–81.
Lec, W 10:10; labs, W F 2–4:25. Staff.
Lectures on structure and habits of insect larvae. Lab studies of the literature, comparative morphology, and identification of the immature stages of the Holometabola.]

[633 Taxonomy of the Coleoptera and Lepidoptera Spring. 3 credits. Prerequisite: Entomology 331. Offered alternate years. Not offered 1980–81.
Lec, W 10:10; labs, W F 2–4:25. Staff.
Lab studies on the literature and on the characteristics and classification of representative genera and species of these orders.]

[634 Taxonomy of the Diptera and Hymenoptera Spring. 3 credits. Prerequisite: Entomology 331. Offered alternate years. Not offered 1980–81.
Lec, W 10:10; labs, W F 2–4:25, and 1 other by arrangement. W. L. Brown.
Lab studies on the literature and on the characters and classification of representative genera and species of these orders.]

635 Araneology Fall. 2 credits. Prerequisites: Entomology 212 and permission of instructor. Offered alternate years.
Lec and lab, R 2–4:25. D. B. Zepp.
Introduction to the systematics, morphology, physiology, behavior, and ecology of spiders and the other arachnids, with emphasis on identification and biology. A collection is required.

640 Pest Management Systems Fall. 4 credits. Prerequisites: Biological Sciences 360, Entomology 340 or Plant Pathology 404, and a course in calculus. Recommended: an introductory course in computer science. Offered alternate years.
Lecs, M W F 9:05; disc, W 2:30–4:25. A. J. Sawyer.
Quantitative aspects of the development of pest and agricultural resource management systems. A major portion of the course deals with predictive simulation models and quantitative research. Other topics include philosophy, use of literature, systems analysis, management and design, and communications and monitoring systems.

662 Insect Behavior Seminar Spring. 1 credit. Prerequisites: permission of instructors and either Entomology 212 and Biological Sciences 321 or equivalents.
Hours to be arranged. G. C. Eickwort, M. J. Tauber.

664 Seminar in Coevolution Between Insects and Plants Spring. 2 credits. Limited to 15 students. Prerequisites: entomology, ecology, evolution, organic chemistry, and written permission of instructor. S-U grades optional. Offered alternate years.
One evening a week, to be arranged. P. P. Feeny.
For graduate students and seniors. Presentations and discussions by students on the evolution of patterns of interaction between plants and insects, emphasizing critical evaluation of concepts and evidence.

672 Seminar in Aquatic Ecology Spring. 1 credit. Prerequisites: permission of instructor and either Entomology 471 or Biological Sciences 462, 464. Offered alternate years.
Hours to be arranged. B. L. Peckarsky.
Discussion and analysis of current topics in the ecology of streams and lakes, including synthesis of key papers in the literature. Reports on personal research or ideas by students will be encouraged.

[677 Biological Control Fall. 3 credits. Prerequisites: Entomology 212, Biological Sciences 360, and permission of instructor. Not offered 1980–81.
Lecs, T R 9:05; lab, T 2–4:25. M. J. Tauber.
Theory and method of biological control of arthropod pests and weeds. Lab includes studies with living parasites and predators.]

685 Seminar in Insect Physiology Spring. 1 credit. Prerequisites: Entomology 483 (may be taken concurrently) and permission of instructor.
Hours to be arranged. H. H. Hagedorn.

690 Insect Toxicology and Insecticidal Chemistry Spring. 4 credits. Prerequisites: general chemistry and organic chemistry. Undergraduate students by permission of instructor. Offered alternate years.
Lecs, M W F 9:05; lab, day to be arranged, 1:25–4:25. C. F. Wilkinson.
The chemistry of insecticides and their metabolism and mode of action in insects and mammals.

707 Special Topics for Graduate Students Fall or spring. Credit to be arranged. Prerequisite: permission of instructor.
Staff.

708 Graduate Research Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Not for thesis research.
Staff.

709 Teaching Entomology Credit to be arranged.
Staff.
Teaching entomology or for extension training.

800 Masters Level Thesis Research Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
Staff.

900 Doctoral Level Thesis Research Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
Staff.

Jugatae Seminar Fall and spring.
M 4–5.
A seminar conducted by Jugatae, the entomology club of Cornell University, to discuss topics of interest to its members and guests.

Floriculture and Ornamental Horticulture

C. F. Gortzig, chairman; M. I. Adleman, N. L. Bassuk, A. Bing, J. W. Boodley, E. J. Carter, R. L. Dwelle, A. M. Elliot, C. C. Fischer, R. T. Fox, G. L. Good, T. H. Johnson, R. J. Lambert, R. W. Langhans, A. S. Lieberman, L. J. Mirin, R. G. Mower, F. B. Negm, A. M. Petrovic, E. F. Schaufler, J. G. Seeley, P. J. Trowbridge

Courses by Subject

Commercial floriculture crop production: 424, 425
Freehand drawing and illustration: 109, 111, 210, 211, 214, 316, 417
Horticultural physiology: 401–411, 402, 601
Introductory courses: 100, 105, Landscape Architecture 140, Vegetable Crops 103
Landscape architecture (professionally accredited program): see pages 24 and 48.
Landscape horticulture: Landscape Architecture 140, 220, 221, 311, 340, 425, 431, 432, 531, 532.
Nursery management: 317
Plant materials: 213, 248, 312, 313, 322, 450
Retail floriculture: 105, 325
Special problems in floriculture and ornamental horticulture: 497
Turfgrass management: 314, 318

100 Introductory Floriculture and Ornamental Horticulture Fall. 3 credits. Principally for freshmen. S-U grades optional for students not specializing in floriculture and ornamental horticulture. Field trip costs about $25 plus room and meals.

Lecs, M W 8; lab, T or W 2–4:25. J. W. Boodley.

An introduction to basic plant physiology and plant processes, control of the plant environment, and the floriculture and ornamental horticulture industry and opportunities. A required field trip to visit commercial enterprises is made.

105 Floral Design Fall or spring. 2 credits. Each lab limited to 22 students. Prerequisite: permission of instructor; preference given to plant science majors, then to students in education, design, and journalism studies. Students whose careers will involve using this horticultural expertise should apply. There is a $25 charge to purchase instructional plant materials that the student will keep.

Lec-lab, T W or R 1:25–4:25. C. C. Fischer.

A study of the established floral design techniques of this country presenting the principles and the mechanics of the art to prepare the student to design for varying themes and occasions. Other aspects include selection, preparation, and factors affecting keeping quality of plant materials, emphasizing the economical use of all supplies.

213 Woody Plant Materials Spring. 4 credits.

Lecs, T R 9:05; lab, T 1:30–4:30 (two sections to be arranged) and W or F 2–4:25. R. G. Mower.

A study of the trees, shrubs, and vines used in landscape plantings. Emphasis is on winter identification and their values for use as landscape material.

312 Garden and Interior Plants I Fall. 3 credits.

Lecs, T R 10:10; lab, T 1:30–4:30 (two sections to be arranged). R. G. Mower.

A study of ornamental plants used in garden and interior situations. The first seven weeks cover primarily herbaceous annuals and perennials, with the lab devoted to various practical gardening activities. The remainder of the semester covers the major kinds of foliage and flowering plants used in the home and other interior landscape situations. Emphasis is on identification, use, and general cultural requirements.

313 Woody Plant Materials for Landscape Use Fall. 3 credits. Limited to 30 students. Primarily for landscape architecture majors.

Lec, W 10:10; lab, F 9:05–12:05. R. G. Mower.

A study of the trees, shrubs, vines, and ground covers used in landscape plantings in the northeastern United States. Emphasis is on leaf identification and on characteristics that determine their usefulness as landscape subjects. Opportunity for independent study is provided.

314 Turfgrass Management Fall. 3 credits. Prerequisites: Agronomy 200 and Biological Sciences 242 or permission of instructor.

Lecs, M F 12:20; lab F 1:25–4:25. A. M. Petrovic.

The scientific principles, practices, and materials for the construction and maintenance of lawn, sports, and utility turfgrass areas. Environmental effects on growth are also studied.

317 Nursery Crop Production and Maintenance Fall. 4 credits. Prerequisite: Floriculture 401.

Lecs, M W F 9; lab, M 12:20–2:15, 2:30–4:25. Field trips are included in lab sessions. G. L. Good.

Problems of commercial propagation and growth of nursery plants to marketable stage including harvesting, storing, and packaging nursery stock. Some consideration is given to the planting and culture of landscape plants.

318 Advanced Turfgrass Management Fall. 2 credits. Prerequisites: Floriculture 314 or equivalent, and permission of instructor. Cost of field trip, $10 plus room and meals.

Hours to be arranged. A. M. Petrovic.

A continuation of Floriculture 314, with emphasis on applying scientific principles to management of golf courses, athletic fields, parks, industrial grounds, and sod production. A weekend inspection trip is taken to experimental test plots and special turfgrass areas.

322 Garden and Interior Plants II Spring. 3 credits. Prerequisite: Floriculture 312 or permission of instructor.

Lecs, M W 11:15; lab, M 1:30–4:30 (two sections to be arranged). R. G. Mower.

A continuation of Floriculture 312. The first seven weeks are devoted to a further study of interior plants with emphasis on specialized groups of interior plants as orchids, cacti and succulents, gesneriads, ferns, palms, and bromeliads. The second seven weeks are devoted to outdoor herbaceous plants such as tulips, daffodils, crocus, iris, as well as other spring-blooming bulbs and perennial plants. Outdoor labs emphasize practical gardening activities appropriate to the spring season.

325 Flower-Store Management Fall. 3 credits. Prerequisites: Floriculture 105 and permission of instructor. Lab materials charge, $25. Cost for field trips, $15 plus room and meals.

Lecs, W F 11:15–12:20; lab, F 1:25–4:25. R. T. Fox.

Lectures devoted to flower-shop management, business methods, merchandising, and marketing of floricultural commodities. Labs include the application of subject matter and the principles of commercial floral arrangement and design. Required field trips made to flower shows and to wholesale and retail florist establishemnts.

342 Taxonomy of Cultivated Plants (also Biological Sciences 342) Spring. 4 credits.

Lecs, M W 10:10; labs, M W 2–4:25.
J. W. Ingram, Jr.

A study of ferns and seed plants, their relationships, and their classification into families and genera, emphasizing cultivated plants. Emphasis is on gaining proficiency in identifying and distinguishing families and to preparing and using analytical keys; attention is also given to the economic importance of taxa, to the basic taxonomic literature, and to the elements of nomenclature.

401–411 Physiology of Horticultural Plants Fall. 401 (lec), 2 credits; 411 (lab), 1 credit. Each lab limited to 40 students. Prerequisite: Biological Sciences 242 or 342 or permission of instructor.

Lecs, T R 8; lab, R 1:25–4:25. Staff.

Application of physiology to germination of seeds, rooting of cuttings, manipulation of bulbs, and propagation of plants by budding and grafting. Stress on basic mechanisms concerning initiation and development of roots and shoots.

402 Physiology of Horticultural Plants Spring. 4 credits. Prerequisite: Biological Sciences 242 or 342 or permission of instructor.

Lec, M W F 8; lab to be arranged. F. B. Negm.

A study of the physiology of growth and development of horticultural plants in response to their environment.

424 Principles of Florist Crop Production Spring. 4 credits. Limited to 40 students, with 20 per lab section. Preference given to juniors. Prerequisites: Floriculture 401 and Biological Sciences 242, 342 (may be taken concurrently), or equivalent; or permission of instructor. Cost for field trips, $20 plus meals.

Lecs, M W F 9:05; lab, M or R 2–4:25. J. G. Seeley.

Commercial production of florist crops. Emphasis on principles of culture of ornamental plants as influenced by greenhouse environment. Field trips are made to commercial greenhouses.

425 Greenhouse Production Management Spring. 4 credits. Primarily for seniors. Prerequisite: an elementary course in horticulture or equivalent. Cost for field trips, $100.

Lecs, T R 10:10–12:05. Two field trips are taken.
R. W. Langhans.

Intended to provide the latest information on efficient operation and administration of a commercial greenhouse, outside the sphere of production methods for specific crops. Consideration is given to the industry, centers of production, competition, location, types of structures, heating, ventilation, cooling, fertilizing, and watering systems, and business analysis and management.

450 Special Topics on Ornamental Plants Fall or spring. Credit to be arranged. Limited to 15 students. Primarily for upperclass floriculture and ornamental horticulture majors. Prerequisites: Floriculture 213, 312, or 313 or the equivalent, and permission of instructor.

Hours to be arranged. R. G. Mower.

Topical subjects in plant materials. Independent and group study of important groups of woody and herbaceous plant materials not considered in other courses. The topic is given in the supplementary announcement.

497 Special Problems in Floriculture and Ornamental Horticulture 1 or more credits. S-U grades optional. Prerequisite: students must satisfy the staff member under whom the work is to be taken that their background warrants their choice of problems. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.

C. F. Gortzig and staff.

Work on problems under investigation by the department or of special interest to the student.

600 Seminar Fall or spring. For department staff and graduate students. S-U grades only.

R 12:10.

601 Current Topics in Floricultural and Ornamental Horticultural Physiology Spring. Variable credit. Prerequisite: permission of instructor.

Hours to be arranged. F. B. Negm.

Discussions of modern concepts, research, and commercial problems as reflected in current horticultural literature.

Freehand Drawing and Illustration

109 Drawing for Landscape Architects Fall. 3 credits. Primarily for department majors; others admitted with permission of instructor. Limited to 25 students.

Lec, R 10:10; studio, T 9:05–11, R 1:25–4:25.
A. Elliot.

Emphasizes the development of a graphic language and an approach to freehand perspective. Outside sketchbook assignments.

111 Freehand Drawing Fall or spring. 3 credits. Each section limited to 25 students. Prerequisite: permission of instructor. S-U grades optional. Credit may not be received for both Floriculture 109 and 111.
Fall: M W F 10:10–12:05; R. J. Lambert. Spring: Lec, T or W 10:10; 5 additional studio hours a week scheduled in 2- or 3-hour periods during M T W R F 9:05–12:05, T 2–4:25; A. Elliot.
Objective is to develop accuracy of observation and skill in delineation. Practice is given in outdoor sketching and still-life and figure drawing. Principles of freehand perspective are taught and applied. Outside sketchbook assignments.

210 Perspective for Landscape Architects Spring. 3 credits. Primarily for department majors.
T R 1:25–4:25. R. J. Lambert.
Practice in perspective construction from plans and elevations, rendering techniques, and basic design principles. Outside sketchbook assignments.

211 Freehand Drawing and Illustration Fall. 2 credits. Prerequisite: Floriculture 111 or equivalent. S-U grades optional.
6 studio hours scheduled in two- or three-hour units between 9:05 and 12:05 M T W R F. R. J. Lambert.
Progression to the organization of complete illustrations. Subject matter largely from sketchbooks, still life, and imagination. Composition, perspective, and ways of rendering in different media are considered.

214 Watercolor Spring. 2 credits. Prerequisite: Floriculture 111 or equivalent. S-U grades optional.
6 studio hours scheduled in two- or three-hour units between 9:05 and 12:05 M T W R F. R. J. Lambert.
A survey of watercolor techniques. Subject matter largely still life, sketchbook, and on-the-spot outdoor painting.

316 Advanced Drawing Fall or spring. 2 credits. Prerequisite: Floriculture 211 or permission of instructor. S-U grades optional.
6 hours to be arranged. A. Elliot, R. J. Lambert.
For students who want to attain proficiency in a particular type of illustration or technique.

417 Scientific Illustration Fall. 2 credits. Prerequisite: Floriculture 211 or 316 or equivalent. S-U grades optional for graduate students only.
6 studio hours scheduled between 9:05 and 12:05 M T W R. A. Elliot.
A survey of methods of illustration. Training in techniques of accurate representation in media suitable for reproduction processes, including pen and ink, scratchboard, wash, and mixed media.

Landscape Architecture

M. I. Adleman, program coordinator; E. J. Carter, R. L. Dwelle, T. H. Johnson, A. S. Lieberman, L. J. Mirin, P. J. Trowbridge

The Landscape Architecture Program at Cornell is sponsored by the College of Agriculture and Life Sciences through the Department of Floriculture and Ornamental Horticulture and the College of Architecture, Art, and Planning.

140 Introduction to Landscape Design Fall or spring. 3 credits.
Lecs, M W F 9:05. R. L. Dwelle.
An introduction to landscape design as well as interrelated horticultural considerations associated with the built environment. Guest lecturers in landscape architecture, ornamental horticulture, and related fields are scheduled throughout the semester.

Design Studios

201 Design I: Basic Landscape Architectural Design Fall. 5 credits. Limited to landscape architecture majors. Cost of drafting equipment (to be used throughout the 6-studio sequence) and supplies, about $200. Basic expenses for field trip, about $125.
Lec, M 12:20; studio, M W F 1:25–4:25.
T. H. Johnson.
An introduction to the principles of landscape architectural design. The course introduces graphics and drafting, two- and three-dimensional design, color, abstraction, form, space and spatial sequence, uses of plant material, site inventory and analysis, and the site design process. This is the first course in a sequence of 6 studio courses required for specialization in landscape architecture. Participation in the program's 5-day field trip is required.

202 Design II: Basic Landscape Architectural Design Spring. 5 credits. Prerequisite: Landscape Architecture 201. Cost of supplies, about $100.
Lec, F 9:05; studio, M W F 10:10–12:35.
M. I. Adleman.
A continuation of the exposure to basic problem solving and the design process, with emphasis on the development of site design and graphic skills. Projects deal with the organization of outdoor space and the siting of buildings as well as the interrelationships of vehicular and pedestrian circulation, parking, open space, earth form, and vegetation.

301 Design III: Intermediate Landscape Architectural Design Fall. 5 credits. Prerequisite: Landscape Architecture 202. Cost of supplies, about $100. Basic expenses for field trip, about $125.
Lec, F 9:05; studio, M W F 10:10–12:35. Required 5-day field trip. P. J. Trowbridge.
Application of planning and urban design techniques to environmental problems. Timely issues are investigated. Site development problems at several scales and land-use intensities are examined .

302 Design IV: Intermediate Landscape Architectural Design Spring. 5 credits. Prerequisite: Landscape Architecture 301. Cost of supplies, about $100.
Lec, M 12:20; studio, M W F 1:25–4:25.
T. H. Johnson.
Design exercises focus on the synthesis of conceptual ideas into three-dimensional compositions. Ideas from synectics, organizational systems, activity systems, historic spaces, and sculptures are used to compose hard space, soft space, regional space, and total energy environments.

401 Design V: Advanced Landscape Architectural Design Fall. 5 credits. Prerequisites: Landscape Architecture 302 and concurrent registration in Landscape Architecture 425. Cost of supplies, about $100. Basic expenses for 5-day field trip, about $125.
Lec, M 12:20; studio, M W F 1:25–4:25. Required 5-day field trip and a 2-day field trip. M. I. Adleman.
Project-planning studies emphasizing the planting design component of site development. Design problems focus on the functional uses and spatial interrelationships of plants in the landscape. Several field exercises deal with aspects of planting implementation normally specified by the landscape architect. A 2-day field trip is made to selected sources of nursery stock.

402 Design VI: Advanced Landscape Architectural Design Spring. 5 credits. Prerequisite: Landscape Architecture 401. Cost of computer time, supplies, and reproductions about $100.
Lec, F 9:05; studio, M W F 10:10–12:35.
P. J. Trowbridge.
An application of inventory and analysis methods to timely problems in both urban and rural environments. Several documentation formats are investigated, including computer mapping techniques.

***501 Graduate Landscape Architectural Design Studio** Fall. 5 credits.
L. J. Mirin and staff.

502 Graduate Landscape Architectural Design Studio Spring. 5 credits.
Lec, T 12:20; studio, T R 1:30–4:25. T. H. Johnson.
Design exercises focusing on the synthesis of conceptual ideas into three-dimensional compositions. Ideas from synectics, organizational systems, activity systems, historic spaces, and sculptures are used to compose hard space, soft space, regional space, and total energy environments.

***601 Graduate Landscape Architectural Design Studio** Fall. 5 credits.
Staff.

Landscape History and Theory

220 Principles of Landscape Architecture Fall. 2 credits.
Lecs, M W 9:05. P. J. Trowbridge.
An introduction to the basic principles involved in inventory and analysis techniques as they relate to design implementation in the outdoor environment. Case studies depicting application of these principles at all scales of land planning and design are presented. American landscape history and basic design theory as applied to the practice of landscape architecture are emphasized.

221 Principles of Landscape Architecture Fall. 1 credit. Prerequisite: concurrent registration in Landscape Architecture 220.
Sem, hours to be arranged. P. J. Trowbridge and staff.
Discussion of 220 lecture material at greater depth. Paper required.

425 Plants and Design Fall. 2 credits. Floriculture 213 or 313. Landscape architecture majors must register concurrently in Landscape Architecture 401.
Lecs, T R 9:05. M. I. Adleman.
A study of planting design principles relating to the functional uses and spatial interrelationships of plants in the man-made environment. Site, horticultural, and maintenance determinants affecting the selection and use of plant materials, as well as planting specifications, cost estimates, and planting implementation processes are included.

***520 Contemporary Issues in Landscape Architecture** Fall. 2 credits.
Lec, T 11:15. L. J. Mirin.

***521 History of Landscape Architecture I** Fall. 4 credits.
Lecs, T R 11:15. L. J. Mirin.

522 History of Landscape Architecture II Spring. 3 credits.
Lecs, T R 11:15. L. J. Mirin.

Landscape Materials and Construction

310 Site Construction I Spring. 4 credits. Prerequisite: permission of instructor. Recommended: surveying. Lab fees, $15.
Lecs, M W 9:05; studio, T R 9:05–11.
P. J. Trowbridge.
Lectures, short exercises, and projects dealing with land-form design and the preparation of grading plans, calculation of earthwork, and layout of circulation systems, parking, and site utility systems.

*Offered through the College of Architecture, Art, and Planning.

311 Site Construction II Fall. 4 credits.
Prerequisite: permission of instructor. Lab fees, $15.
Lecs, T R 1:25–2:15; studio, T R 2:30–4:25.
T. H. Johnson.
The nature of construction materials and methods of construction used by landscape architects to implement project design proposals. Course includes field trips, lab demonstrations, lectures, and studio work on models; details; and a construction documentation package for a design project.

340 Landscape Design for Nurserymen and Landscape Contractors Fall or spring. 3 credits. Limited to 15 students. Priority given to landscape horticulture majors. Prerequisite: Floriculture 213.
Lec, M 12:20; studio, M W 1:25–4:25. R. L. Dwelle.
Fundamentals of landscape design applied to residential and other small-scale site-planning projects. Work in the studio introduces basic design process, site design principles, construction materials, planting design, and graphics.

431 Introduction to Parks and Recreation Fall. 2 credits.
W 7–9 p.m. E. J. Carter.
This course deals with the park development process and the relationship of parks and recreation facilities to urban, suburban, and rural recreation needs; physical and fiscal resources; overall municipal development efforts; the planning and design profession. Included also are the history of parks and environmental planning issues. The course consists of lectures, discussions, readings, and short papers.

432 Issues in Parks and Recreation Spring. 2 credits.
W 7–9 p.m. E. J. Carter.
The focus is on metropolitan park and open space systems: how such systems help to shape our cities; how they are reflective of the history of attitudes toward recreation, natural systems, and the urban environment; and the role of park and recreation considerations within the comprehensive community planning process. The course consists of lectures and case study presentations, discussions, readings, and short papers.

***530 Urban Landscape Planning and Design** Spring. 3 credits.
L. J. Mirin.

[531 Regional Landscape Inventories and Information Systems: An International Perspective Fall. 3 credits. Primarily for graduate students and upperclass students in landscape architecture. Also open to students in architecture, city and regional planning, ecology, international studies, international agriculture, natural resources, and environmental horticulture. Prerequisites: basic courses in landscape architecture, ecology and systematics, and agronomy and permission of instructor. Not offered 1980–81.
Lecs, M W F 10:10. A. S. Lieberman.
Reading-seminar course exploring major current methodologies, approaches, academic and research centers for landscape inventory and analysis, and supporting land-use and natural resource information systems. Case studies in regional landscape planning in North America, Europe, Australia, and the Middle East.]

[532 Analysis and Use of Vegetation in Comprehensive Land Planning Spring. 3 credits. Primarily for graduate students and upperclass students in landscape architecture. Also open to students in architecture, city and regional planning, ecology, international studies, international agriculture, natural resources, and environmental horticulture. Prerequisites: basic courses in landscape architecture, ecology and systematics, and agronomy and permission of instructor. Not offered 1980–81.
Lecs, M W F 10:10. A. S. Lieberman.
An exploration of vegetation analysis techniques and methods applied to comprehensive land-use planning, followed by consideration of the environmental uses of plants in regional landscape planning. The landscape functions of vegetation at the regional scale are addressed through review of case studies in North America, Europe, the Middle East, and Australia.]

Independent Study

555 Independent Study in Landscape Architecture Fall or spring. 1–3 credits (may be repeated for credit). Limited to students in the Landscape Architecture Program with permission of the faculty member directing the study. S-U grades optional.
Staff.
Work on special topics by individuals or small groups.

***621 Summer Internship Seminar** Fall. 2 credits.
Hours to be arranged. L. J. Mirin.
Primarily for landscape architecture graduate students.

622 Graduate Seminar in Landscape Architecture Spring. 2 credits. Prerequisite: Landscape Architecture 502 (may be taken concurrently).
T 12:20–1:15. T. H. Johnson.
A review of modern designers and their values within the contemporary landscape.

***650 Fieldwork/Workshop in Landscape Architecture** Fall or spring. Credit to be arranged.
Hours to be arranged. Staff.

800 Thesis Research and Preparation in Landscape Architecture Fall or spring. Credit to be arranged. Limited to M.L.A. degree candidates. Prerequisite: permission of graduate field members concerned.
Hours to be arranged. Staff.

Related Courses in Floriculture and Ornamental Horticulture

Woody Plant Materials (Floriculture 213)

Drawing for Landscape Architects (Floriculture 109)

Perspective for Landscape Architects (Floriculture 210)

Turfgrass Management (Floriculture 314)

Food Science

J. E. Kinsella, chairman; J. G. Babish, R. C. Baker, D. K. Bandler, D. M. Barbano, D. H. Beermann, D. C. Graham, R. B. Gravani, L. F. Hood, W. K. Jordan, F. V. Kosikowski, R. A. Ledford, F. W. Liu, R. P. March, D. D. Miller, N. N. Potter, J. M. Regenstein, G. E. Rehkugler, J. W. Sherbon, W. F. Shipe, Jr., J. R. Stouffer, G. H. Wellington, R. R. Zall

100 Introductory Food Science Fall. 3 credits.
M W F 10:10. N. N. Potter.
A comprehensive introduction to food science and technology—its scope, principles, and practices. Topics are: constituent properties, methods of preservation, the major food groups including their handling and processing, and current problems such as chemical additives and world feeding needs. Interrelationships between chemical and physical properties, processing, nutrition, and food quality are stressed.

*Offered through the College of Architecture, Art, and Planning.

101 Topics in Food Science Fall. 1 credit. Limited to food science majors taking Food Science 100. Prerequisite: Food Science 100. A required companion course to Food Science 100.
Lec and disc, F 11:15. N. N. Potter and staff.
Members of the staff lecture and lead discussion on selected topics.

150 Food Choices and Issues Spring. 2 credits. S-U grades optional.
Lecs, T R 12:20. W. F. Shipe, staff, and invited speakers.
A series of lectures dealing with current topics relating to foods. Attempts are made to dispel misconceptions about foods and the factors affecting them.

210 Food Analysis Spring. 3 credits. Prerequisite: Chemistry 104 or 208.
Lecs, W F 12:20; lab, R or F 1:25–4:25.
J. W. Sherbon.
Designed to acquaint the student with chemical tests used by food analysts. Emphasis is on understanding and use of good analytical techniques, including gravimetric, volumetric, and spectrophotometric methods. Procedures for screening, routine quality control, and official tests for fats, proteins, carbohydrates, and selected minor nutrients are introduced.

220 Food Science for Industry Fall. 2 credits.
Lec and lab, F 12:20–4:25. R. C. Baker.
Provides understanding of food industry operations. Half the labs are production of food products (sausages, pastries, etc.) by students and half are visits to commercial plants producing those products. One or two longer field trips may be offered.

247 Postharvest Food Systems Fall. 2 credits. Prerequisite: freshman chemistry. Recommended: Food Science 100. S-U grades optional.
T R 10:10. M. C. Bourne.
This interdisciplinary course describes various courses of postharvest food losses in developing countries and methods available to reduce the losses. Designed for all students in agriculture. Emphasis on cereal grains. Biology and control of rodents, birds, insects, and molds in stored foods, chemical causes of quality loss, simple drying and storage practices, effects of climate. Economic and social factors affecting food preservation and storage technology are discussed.

300 Physical Chemistry of Goods I Fall. 3 credits. Not open to graduate students. Prerequisite: Mathematics 111 or equivalent.
Lecs, M W 11:15; disc, F 12:30–2:15 or 2:30–4:15.
An introduction to the principles of molecular structure, energetics, and kinetics is offered, with applications of these principles to food systems and similar biological materials. Topics include thermodynamics, properties of solutions, phase equilibria, reaction mechanisms, and transport phenomena.

301 Nutritional Aspects of Raw and Processed Foods (also Nutritional Sciences 301) Spring. 3 credits. Prerequisite: Nutritional Sciences 115 or permission of the instructor.
M W F 9:05. D. Miller.
An evaluation of the nutritional qualities of human foods with an emphasis on changes that occur during processing and storage. Topics including food processing methods, dietary trends, vegetarian diets, fabricated foods, fast foods, and food additives will be discussed in the context of their potential impact on nutrition and health.

302 Introduction to Food Engineering Fall. 4 credits. Prerequisites: Food Science 100 and physics.
Lecs, M W F 10:10; lab, M 1:25–4:25. W. K. Jordan.
Engineering aspects of dairy and food plant operations.

304 Food Sanitation As Related to Public Health Spring. 3 credits. Prerequisite: Food Science 100.
Lecs, T R 10:10; lab, R 1:25. R. R. Zall.
Deals with the sanitary principles and control measures essential in producing and processing wholesome and safe foods. Rules and regulations of the U.S. Public Health Service, the Food and Drug Administration, the U.S. Department of Agriculture, and other organizations important to the food industry are covered.

[311 Milk and Frozen Desserts Fall. 2 credits. Prerequisite: Food Science 100 or equivalent or permission of instructor. Offered alternate years. Not offered 1980–81.
Lec, W 12:20; lab, W 1:25. W. K. Jordan, R. R. Zall.
Deals with the principles and practices of processing fluid milk products and frozen desserts. The chemical, microbiological, and technological aspects of processing these dairy products are considered. Field trips to processing plants supplement the lectures and lab work.]

351 Milk Quality Spring. 1 credit. Prerequisite: Animal Science 350 (may be taken concurrently) or permission of instructor.
Lec, F 12:20. D. K. Bandler, R. R. Zall.
Aspects of farm sanitation and milk handling as they apply to milk quality. Quality control tests, farm bacteriology, cleaning, and sanitizing. Special problems of marketing fresh and manufactured dairy products.

394 Food Microbiology Lectures Spring. 2 credits. Prerequisites: Microbiology 290 and 291.
M W 12:20. R. A. Ledford.
The major families of microorganisms of importance in foods are studied systematically, with emphasis on the roles of these organisms in food preservation, food fermentations, and public health.

395 Food Microbiology Laboratory Spring. 2 credits. Graduate students must have permission of the instructor.
M W 2–4:25. R. A. Ledford.
Work includes study of the physiological characteristics of representative food microorganisms, practice in using general and special methods for microbiological testing and control of food products, and practice in isolating and characterizing organisms of importance in foods.

[401 Concepts of Product Development Spring. 2 credits. Prerequisite: Food Science 100 or equivalent. S-U grades optional. Offered alternate years. Not offered 1980–81.
M W 10:10. L. F. Hood.
A discussion of the sequence of events involved in developing and marketing new food products. Topics include packaging and labeling, food additive and ingredient regulations, taste panels, market testing, market research, and patents.]

[402 Product Development Laboratory Spring. 2 credits. Limited to food science majors. Prerequisite: concurrent registration in Food Science 401 and permission of instructor. S-U grades optional. Offered alternate years. Not offered 1980–81.
Labs, W F 1:25–4:25. L. F. Hood.
Emphasis is on gaining practical experience in the development of new foods.]

403 International Food Science and Development Fall. 3 credits. Offered alternate years.
Lecs, T R 11:15; disc, R 1:25–4:25.
F. V. Kosikowski.
A critical evaluation of man's needs for food in the world and the international food technologies, organizations, and policies to meet such needs. Novel extrusion, ultrafiltration, and fermentation food processes and basic nutrient foods for developing countries are described. The making of representative high energy and protein foods, including soybean milk, tofu, sufu and tempeh will be demonstrated in the laboratory.

[404 Food Processing I—Drying, Freezing, Heat Preservation Spring. 3 credits. Prerequisite: Food Science 100 or equivalent. Offered alternate years. Not offered 1980–81.
Lecs, T R 11:15; lab, T 1:25–4:25. N. N. Potter.
Deals with the principles and practices of drying, freezing, canning, and other heat treatments applied to foods. Current processing methods and their relations to the chemistry, microbiology, and technology of the ingredients and final products are discussed.]

405 Food Processing II—Concentrating, Separating, Mixing Spring. 3 credits. Prerequisites: 302 and Microbiology 290 and 291. Offered alternate years.
Lecs, T R 11:15; lab, T 1:25–4:25. W. K. Jordan, R. R. Zall.
Deals with the principles and practices of evaporation, reverse osmosis, homogenization, size reduction, waste management, and other unit operations important to the food industry.

[406 Food Processing III Lecture—Fermentations Fall. 3 credits. Prerequisite: background in microbiology. Offered alternate years. Not offered 1980–81.
Lecs, T R 11:15; disc, R 1:25–4:25.
F. V. Kosikowski.
Principles and practices of viniculture and enology, cheese technology, and related fermentations leading to important foods from fruits, grains, vegetables and milk, animal, and microbial sources. Taste evaluations and illustrated descriptions of wines, beers, cheeses, fermented milks, and exotic fermented foods are included.]

407 Processing Fats and Oils Fall. 3 credits. Offered in even years.
Lecs, W F 9:05; lab, F 1:25–4:25. J. E. Kinsella.
Sources, composition, and properties of edible fats and oils are discussed. Effects of lipids on food quality and storage stability and factors affecting chemical and physical stability of food fats are described. Chemical technology of emulsions, shortenings, edible oils, margarine, and butter is taught.

[408 Food Processing Fermentations Laboratory Fall. 2 credits. Enrollment limited. Prerequisite: concurrent registration in Food Science 406. Offered alternate years. Not offered 1980–81.
Lab, T 1:25–4:25. Required short field trips.
F. V. Kosikowski.
Laboratory exercises and demonstrations in the making of wines, beers, cheeses, fermented milks, and vegetable foods. Field trips provide additional experience.]

409 Food Chemistry Fall. 3 credits. Prerequisite: Biological Sciences 330 or 331.
Lecs, T R 8–9:25. W. F. Shipe, L. F. Hood, J. E. Kinsella, J. M. Regenstein.
Deals with the relationship between the chemical composition and properties of foods. Attention is given to the interactions among the components of food.

410 Sensory and Objective Evaluations of Foods Spring. 3 credits. Prerequisite: statistics.
Lecs, M W F 11:15. W. F. Shipe.
Deals with the sensory techniques used in evaluating the flavor, color, and texture of foods and the effects of these properties on consumer acceptance. Objective methods for measuring these qualities and appropriate statistical methods for analyzing the subjective and objective results and establishing a quality-control program.

411 Food Mycology Fall. 3 credits. Prerequisite: Microbiology 290 or 291 or equivalent. Recommended: Microbiology 394. Offered alternate years.
Lecs, T R 10:10; lab, W 1:25–4:25. D. C. Graham.
To acquaint students with important fungi, from the standpoint of their beneficial as well as their harmful effects in food production, preservation, and spoilage. Labs deal with morphology, culture and isolation, identification of fungi, and isolation and quantification of fungal toxins.

[413 Function of Food Ingredients Spring. 1 credit. Prerequisite: Food Science 409. S-U grades optional. Offered alternate years. Not offered 1980–81.
Lec, F 10:10. L. F. Hood.
Intended for food science majors anticipating product development, production, or quality-control assignments in the food industry. Functional properties of classes of ingredients and their potential interactions with other food constituents are discussed. Guest lecturers from ingredient suppliers participate.]

415 Principles of Food Packaging Fall. 3 credits.
Lecs, M W F 9:05.
Intended primarily for students in food science and related fields. The basic properties of some packaging materials and systems are discussed and applied to specific packaging systems for meats, dairy products, fruits and vegetables, fats and oils, etc.

419 Food Chemistry Laboratory Spring. 2 credits. Prerequisites: Biological Sciences 330 or 331 and Food Science 409.
Lab, T 1:25–4:25. D. Miller.
Intended to complement Food 409 in developing an understanding of the chemistry of food. Lab exercises deal with the chemical properties of food components and changes these components undergo in processing and storage. The relationship between the chemical composition of foods and functional, nutritional, and organoleptic properties are stressed.

497 Special Topics in Food Science Fall or spring. 3 credits maximum. Prerequisite: permission of instructor. S-U grades optional.
Staff.
For the food science student. May include individual tutorial study, a special lecture topic selected by a professor or a group of students, or selected lectures of a course already offered. As topics may be changed, the course may be repeated for credit.

499 Undergraduate Research in Food Science Fall or spring. 2 credits. S-U grades optional. Students must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade. Except for students enrolled in the honors program, credit will be limited to 4 credits.
Hours to be arranged. Staff.
Independent study.

600 Seminar Fall or spring. 1 credit. Required of all food science graduate students. S-U grades only.

[601 Food Protein Chemistry Fall. 3 credits. Limited to graduate students and to seniors with permission of the instructor. Prerequisite: Food Science 300 or its equivalent. Students who have already had Biological Sciences 631 may not take this course for credit. Offered alternate years. Not offered 1980–81.
Lec, M W F 10:10. J. M. Regenstein.
The chemistry and physical chemistry of proteins are discussed. Important proteins of food systems are examined in terms of methodology currently used in protein chemistry for characterization and purification. Interactions of proteins with other food components are also covered.]

[602 Food Lipids Spring. 2 credits. Limited to graduate students. Offered alternate years. Not offered 1980–81.
T R 12:20. J. E. Kinsella.
Disposition of lipid materils in foods and how lipids influence the chemical and physical attributes of various foods. Effects of storage, heating, refrigeration, and enzymes on food lipids and the chemical mechanisms of oxidation. Importance of lipids to food flavors.]

[603 Food Carbohydrates Spring. 2 credits. Limited to qualified seniors and graduate students. Prerequisite: Biological Sciences 330 or equivalent. Offered alternate years. Not offered 1980–81.
Lecs, T R 10:10. L. F. Hood, R. S. Shallenberger.
A consideration of the chemistry of carbohydrates in foods including sugars, starches, pectins, gums, and cellulose. Emphasis is on their intrinsic chemistry, their origins in raw materials, and the subsequent changes occurring during processing and storage.]

604 Chemistry of Dairy Products Fall. 2 credits. Prerequisites: qualitative and quantitative analysis and organic chemistry. Offered alternate years.
Lecs, T R 12:20. D. M. Barbano.
A study of milk constituents and physical properties. Deals with milk enzymes, lactose, milk fat, milk proteins, and minor constituents and includes biological variations and processing effects.

605 Application of Physical Chemistry to Foods Fall. 1 credit. Not open to students who have completed or are registered in Food Science 710. Prerequisite: physical chemistry or concurrent registration in Food Science 300.
Lec, F 11:15.
The application of physical chemical principles to important food systems, with emphasis on emulsions.

606 Instrumental Methods Fall. 5 credits. Prerequisite: permission of instructor.
Lec, M W F 8; lab, W or R 1:25–4:25.
J. W. Sherbon.
Deals with instrumental methods widely used in research and industry. The major emphasis is on chromatography, spectroscopy, electrophoresis, thermal analysis, and the use of computers. The stress is on the theoretical and practical aspects of the material presented.

[608 Food Color and Food Pigments Fall. 1 credit. Prerequisite: organic chemistry. Offered alternate years. Not offered 1980–81.
Lec, F 12:20. J. P. VanBuren.
An introduction to theories of color perception and color spaces, followed by a survey of chemical and physical properties of the major food pigments and their stability during processing and storage. Color and pigments of selected commodities are examined.]

[609 Rheology Fall. 1 credit. Offered alternate years. Not offered 1980–81.
Lec, T 12:20. M. C. Bourne.
Fundamental concepts of rheology applied to foods, with emphasis on objective methods for measuring textural properties. Principles and practice involved in measuring texture, viscosity, texture profiling, and consistency; instrumentation and correlations between objective and sensory methods of texture measurements. Examples of rheological problems in each major food group.]

610 Introductory Chemical Toxicology Fall. 1 credit. Prerequisites: biochemistry and animal physiology. Offered alternate years.
Lec, F 11:15. G. S. Stoewsand.
An introduction to the concepts and essentials of toxicology, especially as related to foods; physiologically active compounds in natural and processed foods; antinutritive substances; intentional food additives; potential contaminants; safety evaluation and regulation of foods. Writing or a brief student lecture is assigned, to widen knowledge of current research.

[614 Mathematical Evaluation of Processed Packaged Foods Spring. 3 credits. Offered alternate years. Not offered 1980–81.
Lec and disc, R 2–4:25.
Mathematical methods used to evaluate the thermal processing of packaged foods are presented in depth. These techniques are used in predicting shelf life and nutrient loss.]

615 Secondary Plant Metabolites in Foods Fall. 1 credit. Prerequisite: Biological Sciences 330 or 331. Offered alternate years.
Lec, F 12:20. G. Hrazdina.
Deals with the biochemistry of secondary plant metabolites (e.g., sulphur-containing compounds, alkaloids, flavonoids, terpenes) and their importance to food products. Emphasis is on the chemical properties of these compounds, their reactions, their occurrence in edible plants, and their influence on food products.

710 Physical Chemistry of Foods II Fall. 3 credits. Prerequisite: Mathematics 111 or equivalent. Not open to students who have had physical chemistry or Food Science 300. Limited to graduate students.
Lec, M W F 11:15.
The application of physical chemical principles to important systems, with emphasis on emulsions. In addition, an introduction to the principles of molecular structure, energetics, and kinetics is offered, with applications of these principles to understanding foods and other biological materials.

Related Courses in Other Departments

Marketing (Agricultural Economics 240)

Food Industry Management (Agricultural Economics 443)

Introduction to Agricultural Engineering and Computing (Agricultural Engineering 151)

Engineering Design and Analysis of Food Processing Equipment (Agricultural Engineering 468)

Meat and Meat Products (Animal Science 290)

Commercial Meat Processing (Animal Science 392)

Advanced General Microbiology Lectures (Microbiology 390)

Postharvest Handling and Marketing of Vegetables (Vegetable Crops 312)

International Agriculture

300 Perspectives in International Agriculture and Rural Development Fall. 2 credits. S-U grades optional.
F 1:25–3:20. Staff.
A forum to discuss both contemporary and future world food issues and the need for an integrated, multidisciplinary team approach in helping farmers and rural development planners adjust to the ever changing food needs of the world.

600 Seminar: International Agriculture Fall and spring. Noncredit. S-U grades only.
Third and fourth Wednesdays of each month, 4–5.
Staff.
The seminar focuses on developing an understanding of the nature and interrelatedness of agricultural development and the social sciences, plant and animal sciences, foods and nutrition, and natural resources.

601 Agricultural Development in Southeast Asia Spring. 2 credits. S-U grades optional.
F. H. Golay, G. Levine.
Major aspects of agricultural development in Southeast Asia are considered from economic, social, and technological points of view.

602 Special Studies of Problems of Agriculture in the Tropics Spring. 3 credits. Prerequisites: an international agriculture course and permission of instructors. Cost of field-study trip, $400 for lodging, meals, personal expenses, and a portion of transportation.
R 2:30–4:25. Staff.
Oriented to provide students an opportunity to observe agricultural development in a tropical environment and promote interdisciplinary exchange among staff and students. The two-week field-study trip during January to Latin American countries is followed by discussions and assignments dealing with problems in agriculture and livestock production in the context of social and economic conditions.

603 Administration of Agricultural and Rural Development (also Government 692 and B&PA NCE 514) Spring. 3 credits. S-U grades optional.
T 2:30–5:30. M. L. Barnett, J. L. Compton, M. J. Esman, N. T. Uphoff, L. W. Zuidema.
An intercollege course designed to provide graduate students a multidisciplinary perspective on the administration of agricultural and rural development activities in developing countries. The course is oriented to students trained in agricultural and social sciences who are likely to occupy administrative roles during their professional careers.

604 Seminar on African Agriculture and Rural Development Fall. 2 credits. S-U grades optional.
M 1:25–3:20. Staff.
Strategies for increasing food production and raising rural incomes in Africa. Topics include cropping systems in Africa and the role of agricultural technology in increasing yields, improving livestock production, strategies for improving human nutrition, food storage and mechanization, rural employment projects, alternative rural development strategies, and experience with World Bank and other internationally funded rural development projects.

650 Special Topics in International Agricultural and Rural Development Fall and spring. 1–3 credits. S-U grades optional.
Staff.
A seminar on current themes of agricultural and rural development. Specific content varies each semester.

703 Seminar for Special Projects in Agricultural and Rural Development Spring. 1 credit. Required for graduate students enrolled in the M.P.S. (Agr.) degree program and majoring in international agricultural and rural development; others with permission of the program director. S-U grades only.
Hours to be arranged. Staff.
The seminar provides students the opportunity to present their special projects. It also serves as a forum for discussion of current issues in low-income agricultural and rural development, with particular attention to interdisciplinary complexities.

899 International Agricultural and Rural Development Project Paper Fall and spring. 1–6 credits. Limited to M.P.S. candidates in international agriculture and rural development. S-U grades only.
Staff.

Related Courses in Other Departments

Economics of Agricultural Geography (Agricultural Economics 150)

Agricultural Trade Policy (Agricultural Economics 430)

Economics of Agricultural Development (Agricultural Economics 464)

Food, Population, and Employment (Agricultural Economics 660–661)

Microeconomic Issues in Agricultural Development (Agricultural Economics 664)

Seminar on Latin American Agricultural Policy (Agricultural Economics 665)

Seminar in Agricultural Development (Agricultural Economics 666)

Seminar on Agricultural Trade Policy (Agricultural Economics 730)

Export Marketing (Agricultural Economics 743)

Production of Tropical Crops (Agronomy 314)

Geography and Appraisal of Soils of the Tropics (Agronomy 401)

Management Systems for Tropical Soils (Agronomy 480)

Livestock Production in Warm Climates (Animal Science 400)

[Forages of the Tropics for Livestock Production (Animal Science 403)]

Intercultural Communication (Communication Arts 601)

Communication in the Developing Nations (Communication Arts 624)

Designing Extension and Continuing Education Programs (Education 624)

Behavioral Change in International Rural Modernization (Education 627)

Comparative Extension Education Systems: Structural-Functional Perspectives (Education 629)

Postharvest Food Systems (Food Science 247)

International Food Science and Development (Food Science 403)

Political Economy of Change: Rural Development in the Third World (Government 648)

Regional Landscape Inventories and Information Systems: An International Perspective (Landscape Architecture 531)

[Analysis and Use of Vegetation in Comprehensive Land Planning (Landscape Architecture 532)]

National and International Food Economics (Nutritional Sciences 457)

International Nutrition Problems, Policy, and Programs (Nutritional Sciences 680)

Seminar in International Nutrition and Development Policy (Nutritional Sciences 695)

Special Topics in International Nutrition (Nutritional Sciences 699)

Plant Diseases in Tropical Agricultural Development (Plant Pathology 655)

[Economic Fruits of the World (Pomology 208)]

Rural Sociology and World Development Problems (Rural Sociology 105)

Rural Development and Cultural Change (Rural Sociology 355)

Subsistence Agriculture in Transition (Rural Sociology 357)

Contemporary Sociological Theories of Development (Rural Sociology 606)

Social Organization of Agriculture (Rural Sociology 650)

Macrosocial Accounting (Rural Sociology 715)

Social Movements in Agrarian Society (Rural Sociology 723)

Applications of Sociology to Development Programs (Rural Sociology 751)

Sociotechnical Aspects of Irrigation (Rural Sociology 754)

Landscape Architecture

The Landscape Architecture Program at Cornell is sponsored by the College of Agriculture and Life Sciences through the Department of Floriculture and Ornamental Horticulture and the College of Architecture, Art, and Planning. See pages 24 and 48.

Microbiology

R. P. Mortlock, chairman; E. A. Delwiche, N. C. Dondero, W. C. Ghiorse, E. P. Greenberg, C. M. Rehkugler, P. J. VanDemark, S. H. Zinder

290 General Microbiology Lectures Fall or spring. 3 credits. Prerequisites: Biological Sciences 101–102 and Chemistry 104 or 208. Recommended: concurrent registration in Microbiology 291.
M W F 11:15. Fall, W. C. Ghiorse; spring, P. J. VanDemark.
A study of the basic principles and relationships in the field of microbiology, with fundamentals necessary for further work in the subject.

291 General Microbiology Laboratory Fall or spring. 2 credits. Prerequisite: Microbiology 290 (may be taken concurrently).
M W 2–4:25 or 7–9:30 p.m. or T R 8–10:30, 11:15–1:45, or 2–4:25. Fall, W. C. Ghiorse; spring, P. J. VanDemark.
A study of the basic principles and techniques of laboratory practice in microbiology and fundamentals necessary for further work in the subject.

292 General Microbiology Discussion Spring. 1 credit. Prerequisite: Microbiology 290 (may be taken concurrently). S-U grades only.
Hours to be arranged. P. J. VanDemark.
A series of discussion groups in specialized areas of microbiology to complement Microbiology 290.

314 Tissue Culture Techniques and Applications Fall. 2 credits. Prerequisites: Microbiology 290 and 291 or permission of instructor.
F 1:25–3:30; 3 lab exercises scheduled on a rotating basis, F 3:30–5:30. C. M. Rehkugler.
A series of lectures and demonstrations dealing with cell culture methods, especially those required to culture cells of plants and animals from different tissue origins. The application of cell culture to the study of bacterial diseases, virus replication, and the production of biologicals are considered.

[390 Advanced General Microbiology Lectures Fall. 2 credits. Prerequisites: Microbiology 290 and 291 and organic chemistry. May be taken independently of Microbiology 391 and in sequence with or independently of Microbiology 392. Offered alternate years.
M W 11:15. E. A. Delwiche, N. C. Dondero.
A consideration of the morphological, taxonomic, cultural, and physiological characteristics of important groups of heterotrophic microorganisms. Included will be (1) spore-forming bacteria, propionic acid bacteria, and gram-negative cocci and (2) pseudomonads, enterics, and related forms.]

[391 Advanced General Microbiology Laboratory Fall. 2 credits. Limited to 20 students. Prerequisite: Microbiology 390 (may be taken concurrently). Offered alternate years.
M W 2–4:25. E. A. Delwiche, N. C. Dondero.
Intended as a lab complement to Microbiology 390. The isolation, characterization, and study of the groups of heterotrophic microorganisms included in Microbiology 390.]

392 Advanced General Microbiology Lectures Fall. 2 credits. Prerequisites: Microbiology 290 and 291 and organic chemistry. May be taken independently of Microbiology 393 and in sequence with or independently of Microbiology 390. Offered alternate years.
M W 11:15. P. J. VanDemark, E. P. Greenberg.
A consideration of the morphological, taxonomic, cultural, and physiological characteristics of important groups of heterotrophic microorganisms. Included are (1) lactic acid bacteria and (2) marine bacteria, thermophilic bacteria, and halophilic and halotolerant bacteria.

393 Advanced General Microbiology Laboratory Fall. 2 credits. Limited to 20 students. Prerequisite: Microbiology 392 (may be taken concurrently). Offered alternate years.
M W 2–4:25. P. J. VanDemark, E. P. Greenberg.
Intended as a lab complement to Microbiology 392. The isolation, characterization, and study of the groups of heterotrophic microorganisms included in Microbiology 392.

336 Applied and Industrial Microbiology Fall. 3 credits. Prerequisites: Microbiology 290 and organic chemistry.
T R 10:10–11:25. E. A. Delwiche, N. C. Dondero, and staff.
A survey of the microbiology of industrial fermentations and public health aspects of water and wastewater.

422 Aquatic Microbiology Spring. 3 credits. Prerequisites: Microbiology 290 or Agronomy 406, and organic chemistry.
T R 10:10–11:25. N. C. Dondero.
A consideration of the relation of microorganisms, especially the bacteria, to aquatic environments, both natural and artificial. The microbiology of wastewaters is included. Attention is given to fundamental biological concepts and to applied aspects of the occurrence and activities of microorganisms in water.

424 Microbial Ecology Spring. 3 credits. Prerequisite: an elementary course in some facet of microbiology. Offered alternate years.
M W F 10:10. M. Alexander.
An introduction to the basic principles of microbial ecology. Attention is given to the behavior, activity, and interrelationships of bacteria, fungi, algae, and protozoa in natural ecosystems.

480 Microbial Physiology Lectures Spring. 3 credits. Prerequisites: Microbiology 290 and 291 and biochemistry. S-U grades optional.
M W F 11:15. R. P. Mortlock.
The concern is with the physiological functions of microorganisms. Particular consideration is given to the dynamics of growth, the nutrition and energy metabolism of developing cultures, and the interactions of the physical and chemical environments with the growth process. Composition and structure of microorganisms, metabolism, and various microbial processes such as transport and regulation are discussed.

481 Microbial Physiology Laboratory Spring. 3 credits. Limited to 12 students. Prerequisites: Microbiology 480 (may be taken concurrently) and permission of instructor. S-U grades optional.
T R 12:20–4:25. R. P. Mortlock.
The lab component of Microbiology 480. Experiments designed by the instructor and students to explore fundamental concepts, techniques, and instrumentation in microbial physiology.

484 Cytology of Prokaryotes Lectures Spring. 3 credits. Prerequisites: Microbiology 290 and 291, biochemistry. S-U grades optional. Offered alternate years.
M W F 9:05. W. C. Ghiorse.
An in-depth survey of structure, function, and life cycles of prokaryotic organisms. Form, organization, and function within the prokaryotic domain are considered with respect to aggregates of cells, individual cells, sub-cellular organelles, and macromolecular architecture.

485 Cytology of Prokaryotes Laboratory Spring. 1 credit. Enrollment limited. Prerequisite: concurrent registration in Microbiology 484 and permission of instructor. Offered alternate years.
Hours to be arranged. W. C. Ghiorse.
Cytological techniques, including preparations for light and electron microscopy, that are especially applicable to the study of prokaryotic cells.

486 Selected Topics in Microbial Metabolism Spring. 2 credits. Primarily for upperclass and graduate students. Prerequisites: beginning courses in general microbiology, biochemistry, and organic chemistry. S-U grades optional.
T R 11:15. E. A. Delwiche.
Selected topics pertaining to the energy metabolism, oxidative and fermentative abilities, and biosynthetic capacities of microorganisms. Where possible and appropriate, the subject matter compares the various microbial forms.

497 Special Topics Fall. 1 credit. Limited to upper class students specializing in microbiology, who may desire to take Microbiology 499. Prerequisite: permission of instructor. S-U grades only. The course cannot be used to fulfill the specialization requirement.
Hours to be arranged. Staff.

498 Teaching Experience Fall or spring. 1–3 credits. Enrollment limited. Prerequisites: previous enrollment in the course to be taught or equivalent, and written permission of instructor. S-U grades option with permission of instructor.
Hours to be arranged. Staff.
Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching microbiology courses under supervision of departmental faculty. This experience may include leading a discussion group, preparing, assisting, or teaching a microbiology laboratory, or tutoring. Microbiology courses currently offering such experience include 291 and 292. This course cannot be used to fulfill the specialization requirement.

499 Research in Microbiology Fall or spring. Variable credit. Undergraduates must attach to their course enrollment material written permission of the staff member who will supervise the work and assign the grade. This course cannot be used to fulfill the specialization requirement.
Hours to be arranged. Staff.

691 Graduate Seminar in Microbiology Fall and spring. 1 credit each semester. All graduate students majoring in microbiology must enroll each semester.
Hours to be arranged. Staff.

694 Bacterial Diversity Spring. 4 credits. Prerequisites: either Microbiology 390, 392, or 480, and Biological Sciences 330 or 331 or equivalent.
M W 12:20–4:25. E. P. Greenberg.
Physiology, ecology, and morphology of selected groups of bacteria, including the methanogenic bacteria, spirochetes, nitrogen-fixing bacteria, photosynthetic bacteria, thermophilic bacteria, myxobacteria, and others. Behavior of bacteria in response to environmental stimuli.

699 Microbiology Seminar Fall and spring. Required of all graduate students majoring in microbiology and open to all who are interested.
Hours to be arranged. Staff.

Related Courses in Other Departments

[Soil Microbiology Lectures (Agronomy 406)]

Advanced Soil Microbiology (Agronomy 606)

Insect Pathology (Entomology 453)

Food Microbiology Lectures (Food Science 394)

Food Microbiology Laboratory (Food Science 395)

Food Mycology (Food Science 411)

Basic Immunology Lectures (Veterinary Medicine 315)

Basic Immunology Laboratory (Veterinary Medicine 316)

Pathogenic Microbiology (Veterinary Medicine 317)

Microbial Genetics, Lectures (Biological Sciences 485)

Microbial Genetics, Laboratory (Biological Sciences 486)

[Advanced Immunology Lectures (Veterinary Medicine 705)]

[Advanced Immunology Laboratory (Veterinary Medicine 706)]

Advanced Work in Bacteriology, Virology, or Immunology (Veterinary Medicine 707)

Advanced Animal Virology Lectures (Veterinary Medicine 708)

Advanced Animal Virology Laboratory (Veterinary Medicine 709)

Immunopathology and Clinical Immunology (Veterinary Medicine 712)

Natural Resources

W. H. Everhart, chairman; R. A. Baer, H. B. Brumsted, J. W. Caslick, S. P. Gloss, L. S. Hamilton, E. E. Hardy, T. L. Hullar, J. W. Kelley, J. P. Lassoie, R. J. McNeil, R. A. Malecki, A. N. Moen, R. R. Morrow, Jr., R. T. Oglesby, M. E. Richmond, C. L. Schofield, D. A. Webster, B. T. Wilkins, W. D. Youngs

200 Principles of Conservation Fall. 3 credits. Limited to natural resources majors. Not open to students who have passed Natural Resources 201.
Lecs, M W F 10:10; 1-hour disc to be arranged. R. J. McNeil.
Principles of environmental conservation and application of those principles to the management of natural resources. Ecological concepts, a survey of the natural resources and their properties, and resource management concepts are considered. Social, political, legal, economic, and ethical aspects of environmental issues are discussed.

201 Environmental Conservation Spring. 3 credits. A survey course intended for students in any year and major. Not open to students who have passed Natural Resources 200.
Lecs, M W F 10:10; 1-hour disc to be arranged. R. J. McNeil
People, natural resources, and environment. Ecological principles as applied to human use of environment; survival strategies of animals and the application of these concepts to human use and misuse of environment; a survey of natural resources and problems related to their management. Current issues such as air and water pollution, disposal of radioactive wastes, human population pressures, energy supply and management, and life-style are considered. Social, political, legal, economic, and ethical aspects of environmental concerns are introduced.

210 Introductory Field Biology Fall. 3 credits. Preference given to natural resources sophomores. Prerequisites: Either Biological Sciences 101 and 102 or equivalent. Expenses for field trip, no more than $6.
Lec, W 10:10; lab, M W 1:25–4:25. Overnight field trips. T. Gavin.
Introduction to methods of inventorying, collecting, preserving, and identifying plants, animals, and their habitats. Principles and concepts of systematics and ecology are studied as they apply to both aquatic and terrestrial systems. Selected aspects of current ecological thinking relevant to problems of resource management, particularly the assessment of the distribution and abundance of organisms, are stressed. Observation and recording of field observations are emphasized.

250 Introductory Wildlife Biology Spring; first third of term. 1 credit. Prerequisites: Natural Resources 210 and junior standing.
Lec, M W F 8. A. N. Moen.
Introduction to the biological characteristics of wildlife species, with analyses of these characteristics in relation to ecology and management.

251 Introductory Fishery Biology Spring; middle third of term. 1 credit. Prerequisites: Natural Resources 210 or permission of instructor.
Lec, M W F 8. Staff.
Importance of basic life history, ecology, and measureable parameters as a bases for fishery management. Representative commercial and recreational fisheries will be used as examples.

252 Introductory Forestry Spring; last third of term. 1 credit. Prerequisites: Natural Resources 210 or permission of instructor.
Lec, M W F 8. R. R. Morrow.
Appreciation of forests as a natural resource. Importance of ecology and measurement as bases for forest management. Introduction to tree biology and silviculture.

300 Natural Resources Inventories Spring. 3 credits.
Lecs, M W 12:20; lab, M T W 2. E. E. Hardy.
Procedures for inventorying resources, the methods used, and theories of inventory development in relation to present needs. Examination of the processes used in generating currently used inventories, application of methods to improve

existing inventories, and experience in developing inventories are undertaken. Land resource inventories are emphasized.

302 Forest Ecology Fall. 3 credits. Limited to seniors and graduate students. Cost of trip, no more than $20.
Lecs, M W 11:15; lab, M 1:25–4:25. 1 weekend trip, S through M. Staff.
Understanding the wildland environment. Development of ability to identify and analyze what is present, what was present, what is likely to happen in various forest ecosystems. All lab sessions in the field. One required weekend trip to the Adirondacks or other major forest region.

303 Woodland Management Fall. 3 credits. S-U grades optional.
Lecs, T R 11:15; lab, R 1:25–4:25 (1 field trip will end at 5:30). R. R. Morrow.
Designed to give the student the basic information necessary to permit sound woodland management decisions. Field trips to woodlots emphasize variations in value and potential as well as biological growth. Introduction to tree identification, log scaling, timber estimating, tree marking, and stand improvement work. Planting, management, harvesting, marketing, and multiple use are discussed, as well as relationships of forestry to people and to the environment.

305 Maple Sirup Production Spring. 1 credit. S-U grades only. Limited to 20 students. Prerequisite: permission of instructor.
T 12:20–4:25 (4 preliminary seminars, followed by several half-days of fieldwork during the maple season). R. R. Morrow, A. Fontana.
Students work in most phases of the Arnot Forest maple operation and learn modern sap collecting techniques and quality control in making sirup. A 100-tap area is reserved for student installation of a tubing sap collection network.

320 Winter Energetics Spring. 1 credit. Prerequisites: Natural Resources 250.
Lec, lab, and disc, all day M T W R F in residence at Arnot Forest. A. N. Moen.
Field measurements of weather and range conditions in the winter will be related to metabolism, nutrition, and behavior of free-ranging animals at the Arnot Forest during the last week of the January intersession period.

330 Ecological Integration Summer or fall. 3 credits. Prerequisites: Natural Resources 250 or permission of instructor.
Lec, lab, and disc, all day M T W R F in residence at Arnot Forest. A. N. Moen.
Measurements and analyses of weather, watershed, plant community, and animal population characteristics in an integrated ecological way, stressing interrelationships within ecosystems. This course will be held at the Arnot Forest during the three-week summer session beginning the week after commencement.

407 Religion, Ethics, and the Environment Spring. 3 credits. For juniors, seniors, and graduate students; others by permission. S-U grades optional.
T R 9:05; 1-hour disc to be arranged. R. A. Baer.
A study of the effects of Western religion and values on our understanding and treatment of nature. Historical overview, followed by consideration of selected themes, including progress, play and work, objectivity and subjectivity, human finitude and death, and knowledge as control. Also responsibility to future generations; limiting growth and questions of distributive justice; world population and global hunger; implications of environmental programs for minorities, the poor, and other nations; land use; and energy policy.

410 Principles of Wildlife Management Spring. 4 credits. Prerequisite: junior standing, Biological Sciences 360, or permission of instructor. Cost of field trips, no more than $6.
Lec, M W F 8; lab, F 1:25–4:25. One all-day Saturday and one overnight field trip are required. Students are also required to participate in a deer management project requiring additional fieldwork. T. Gavin.
Fundamental characteristics and mechanisms of wildlife populations and habitats. Includes ecological, social, and economic aspects of wildlife management. Lab includes survey of economically important North American species as well as field trips illustrating methods of habitat management.

411 Techniques in Wildlife Science Spring. 2 credits. Prerequisite: Natural Resources 410 or permission of instructor.
Lec, F 11:15; lab, F 1:25–4:25. J. W. Caslick.
An introduction to techniques used in wildlife research and management, with emphasis on field methods and northeastern game species.

414 Selected Topics in Wildlife Resource Policy Spring. 2 credits. Intended for juniors and seniors. Prerequisite: Natural Resources 410 or equivalent. S-U grades optional. Cost of field trips, no more than $25.
T 2–4:30. Several field trips usually taken weekdays; one overnight field trip to Albany. H. B. Brumsted.
A seminar devoted to analysis of selected current policy issues in wildlife management. Particular attention is given to citizen roles in policy development.

[430 Dynamics of Animal Populations Spring. 2 credits. For seniors and graduate students in natural resources; others by permission of instructor. Offered alternate years. Not offered 1980–81.
T R 10:10. W. D. Youngs.
A quantitative examination of the dynamics of animal populations. Interactive computing is used to assist in analysis and understanding of mortality, growth, population estimation, and population interaction.]

438 Fishery Resource Management Spring. 3 credits. Prerequisite: Natural Resources 440 or permission of instructor.
Lecs, T R 8. W. H. Everhart.
Principles and problems in the management of freshwater and marine fishery resources, considered in relation to problems of human population and management of other natural resources.

440 Fishery Science Fall. 3 credits. For seniors majoring in fishery science; others by permission of instructor. Prerequisites: a year of statistics and calculus. Offered alternate years.
M W F 12:20. W. D. Youngs.
Principles and theories involved in dynamics of fish populations. Methods of obtaining and evaluating statistics of growth, population size, mortality, yield, and production are considered.

442 Techniques in Fishery Science Fall. 3 credits. Limited to 15 upperclass and graduate fishery students. Cost of field trips, no more than $30.
T R 1:25–4:25. 1 or more weekend field trips. D. A. Webster.
Emphasis is on methods of collecting fish and related data when information on population dynamics is of paramount importance. Labs include field experience in use of gear and instruments. Opportunities for additional experience in ongoing college fishery research program is provided.

443 Managing the Aquatic Environment Fall. 2 credits. Limited to 30 juniors and seniors not majoring in aquatic science.
Lecs, T R 10:10; S field trip. R. T. Oglesby.
The nature of aquatic environments and effects of humans on them are initial foci. Wise use of aquatic resources is surveyed in terms of human impacts on them, including the introduction of toxicants and nutrients, removal or addition of particular biotic components, and modifications of the physical environment. Emphasis is on lakes, rivers, and estuaries.

490 Practicum in Natural Resources Analysis and Management Fall. 5 credits. For seniors in natural resources; others by permission of instructors.
Hours to be arranged. Staff.
An in-depth exercise in planning the management of selected resources in a defined geographic area. Students work in groups under the supervision of a faculty committee with other faculty members acting as consulting experts. Student groups make oral and written reports on their management plans to a client panel of faculty members and outside evaluators.

494 Research in Fishery Science Fall or spring. Credit to be arranged. S-U grades optional.
Hours to be arranged. J. L. Forney, S. P. Gloss, R. T. Oglesby, C. L. Schofield, D. A. Webster, W. D. Youngs.

495 Research in Wildlife Science Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
Hours to be arranged. Staff.

496 Research in Forestry Fall or spring. Credit to be arranged. S-U grades; letter grade by permission of instructor.
Hours to be arranged. J. P. Lassoie, R. R. Morrow.

498 Research in Resource Analysis and Planning Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional.
R. A. Baer, H. B. Brumsted, E. E. Hardy, T. L. Hullar, J. W. Kelley, R. J. McNeil, B. T. Wilkins.

500 Thesis Research and Professional Projects Fall and spring. Credit to be arranged. Limited to graduate students working on thesis research or professional master's projects. S-U grades only.
Staff.

600 Waterfowl Biology Fall. 3 credits. Prerequisite: permission of instructor.
Lec-labs, T R 1:25–3:50; several field trips. R. A. Malecki.
An introduction to waterfowl and selected webless migrants. Emphasis is on the waterfowl resource in North America; identification of species, their ecological relationships, population dynamics, and management.

601 Seminar on Selected Topics in Fishery Biology Fall or spring. 1 credit.
Hours to be arranged. Staff.

602 Seminar in Natural Resource Analysis for Ecologically Based Planning Spring. 2 credits. S-U grades only.
W 2–4:30. Staff.
Multidisciplinary graduate seminar. Theme changes each year but usually involves a case study of a specific area of land and water. Fieldwork usually required. Engineers, economists, sociologists, soil scientists, foresters, planners, and wildlife and fishery biologists are invited to bring expertise to the planning table.

603 Habitat Ecology Spring. 1 or 2 credits. Limited to 12 seniors and graduate students majoring in natural resources of biological sciences. Prerequisite: permission of instructor. Cost of field trips, no more than $10.
F 12:20. M. E. Richmond.
This course requires an understanding of broad ecological concepts relative to plant-wildlife interactions. The concept of habitat is addressed from the standpoint of island biogeography, and the interactions of habitat size, shape, location, degree of edge, and temporal change are explored. Major land

forms and plant-animal communities of the northeastern United States will be visited during weekend field trips. Paper required.

604 Seminar on Selected Topics in Resource Policy and Planning Fall. 1 credit. S-U grades only.
Hours to be arranged Staff.
Primarily for graduate students majoring or minoring in natural resources conservation.

[605 Ecology and Management of Disturbed Aquatic Systems Spring. 3 credits. Limited to 20 seniors and graduate students. Recommended for students specializing in the aquatic sciences. Prerequisite: limnology or oceanography. Offered alternate years. Not offered 1980–81
Lecs, T R 10:10; disc, W or F 1:25–3:25; at least 1 S field exercise. R. T. Oglesby.
Lectures and readings focus on responses of aquatic ecosystems to stress and on significance of such reactions. Methods and strategies of management to minimize undesirable aspects of human activities are considered. Detailed case histories are studied and discussed.]

606 Marine Resources Policies Spring. 2 credits. Prerequisite: at least one related course such as Biological Sciences 364, 666, or 668, Natural Resources 438, or permission of instructor. S-U grades optional. Offered alternate years.
R 1:30–3:30. B. T. Wilkins.
A seminar discussing the law and issues concerning current marine policy questions, such as coastal zone management, marine fish regulations, marine mammal protection, and wetland preservation.

[607 Perspectives on Conservation Spring. 3 credits. For graduate students; others by written permission of instructor. S-U grades for graduate students. Offered alternate years. Not offered 1980–81.
R 1:25–3:30. B. T. Wilkins.
A seminar based on extensive readings of articles highlighting varying philosophical approaches to the conservation of natural resources. Views espoused by developmentalists, preservationists, naturalists, economists, and welfare economists are considered.]

608 Policies and Management of Natural and Wild Lands Fall. 2 credits. Prerequisite: permission of instructor. S-U grades optional.
Lec, T 8–9:55. T. L. Hullar.
Lectures, discussions, special seminars, readings, and case studies on natural and wild lands, particularly those in public ownership. Major topics include the values of these lands, social and scientific basis for their establishment, analysis of the policies for preservation and use, and methods and strategies for management. National and state wilderness systems, social and biological carrying capacity, effects of special interests, and current issues are covered. An independent study of a selected area is required.

609 Effects of Ecological Perturbations on Fishes Fall. 3 credits. Prerequisites: Biological Sciences 476 or permission of instructor. Cost of field trips no more than $15.
Lecs, T R 9:05; lab, W 1:25–4:25; several field trips. S. P. Gloss.
Impacts of habitat alteration and physical-chemical pollutants with emphasis on freshwater and diadromous fish species of North America. Direct and indirect effects of a variety of industrial and land-use practices on fish and other aquatic organisms with resultant changes in structure and function of fish communities due to lethal and sublethal responses are discussed. Laboratory includes several field trips.

610 Conservation Seminar Fall and spring. Noncredit. All graduate students in natural resources are expected to participate.
Time to be arranged. Staff.

611 Seminar in Environmental Values Fall. 3 credits. For graduate students, juniors, and seniors. S-U grades optional. Cost of weekend trip, no more than $14.
W 1:25–3:50; two or three extra class sessions for presentations of papers and projects. Weekend trip in late September. R. A. Baer.
How the humanities, particularly religion, philosophy, and ethics, contribute to our understanding of the environment. In successive years topics will include (1) the role of nonutilitarian values in our relationship to our natural environment, (2) land ethics, (3) new models for higher education in the age of ecology, and (4) concepts of growth and progress in Western culture and their impact on our treatment of the environment.

Related Courses in Other Departments

Analysis and Interpretation of Aerial Photographs (Engineering CEE A687)

Biology of Fishes (Biological Sciences 476)

Bionomics of Freshwater Invertebrates (Entomology 471)

Evaluating Resource Investment and Environmental Quality (Agricultural Economics 450)

Ichthyology (Biological Sciences 479)

Limnology (Biological Sciences 402)

Marine Ecology (Biological Sciences 666)

Nature and Properties of Soils (Agronomy 200)

Oceanography (Biological Sciences 461)

Ornithology (Biological Sciences 473)

Phycology (Biological Sciences 348)

Physical Environment Evaluation (Engineering CEE A685)

Resource Economics (Agricultural Economics 350)

Wildlife Pathology (Veterinary Medicine 636)

Plant Breeding and Biometry

W. D. Pardee, chairman; R. E. Anderson, E. D. Earle, H. L. Everett, V. E. Gracen, Jr., P. Gregory, C. C. Lowe, H. M. Munger, M. A. Mutschler, O. H. Pearson, R. L. Plaisted, R. R. Seaney, M. E. Sorrells, D. R. Viands, D. H. Wallace

Biometry courses are listed under "Statistics and Biometry."

225 Plant Genetics Spring. 4 credits. Prerequisite: one year introductory biology.
Lecs, M W F 9:05; lab, W R or F 1:25; lab section assignments at first lecture. Labs start first week. M. A. Mutschler.
An overview of genetic principles are related to plant sciences. Mendelian inheritance and cell mechanics, DNA as genetic material, genetic fine structure and gene regulation, gene recombination, linkage and mapping, gene interaction, extranuclear inheritance, environmental effect on phenotypic expression, gene mutation and chromosomal aberrations, variation in chromosome numbers, genes in populations, multiple gene inheritance, and genetic aspects of pest resistance. Relationship of genetic concepts and techniques to plant breeding. Students conduct an independent inheritance project with *Brassica campestris*.

603 Methods of Plant Breeding Fall. 4 credits. Primarily for graduate students, but open to qualified seniors who expect to engage in plant breeding. Prerequisites: Biological Sciences 101–102, Biological Sciences 281 or Plant Breeding 225, or equivalent; and field crops, vegetable crops, floriculture, or pomology. Students must enroll in this course by August 1.
Lecs, T R 8; labs, T R 1:25–4:15 (labs till 5 during first month). 2 S field trips. R. E. Anderson, H. L. Everett.
Breeding systems for producing commercial crop varieties are considered in detail. Labs include selection techniques, screening for heritable variation, and controlling pollination. Special emphasis is on selection for disease resistance and improved nutritional quality and on use of exotic germ plasm.

605 Physiological Genetics of Crop Plants Spring. 3 credits. Prerequisites: either genetics, biochemistry, and plant physiology, or permission of instructor.
T R 8–10. D. H. Wallace.
Both genetic and environmental influences on biochemical and molecular control of plant variation in physiological phenomena like photosynthesis, respiration, translocation, self-incompatibility, male sterility, maturity, yield, and heterosis are discussed. Emphasis is on variation that can be exploited in plant breeding, particularly in breeding for higher yield and adaptability.

608 Biochemical Analyses for Plant Breeders Fall. 3 credits. Limited enrollment. Prerequisite: permission of instructor. Students must enroll in this course by Aug. 27.
Lecs, M W 1:25–5 (first 4 weeks); lab, M W 1:25–5 (last 10 weeks). P. Gregory.
Acquaints the student with the specialized biochemical analyses commonly used in plant breeding programs. Nutrients and toxicants of several crops are studied. Importance of developing an ability to critically assess the biochemical analyses is emphasized.

612 Experimental Methods Spring. 2 credits. Prerequisite: Plant Breeding 601 or permission of instructor. Offered alternate years.
M W F 12:20. C. C. Lowe.
The use of statistical methods and the application of experimental designs and plot techniques to problems in plant breeding and related agricultural research.

622 Seminar Fall or spring. 1 credit. S-U grades only.
T 12:20. Staff and graduate students.

629 Special Topics in Plant Science Extension Spring. 2 credits.
F 1:25–4:25. W. D. Pardee.
Designed for graduate students and advanced undergraduates, to provide a broader knowledge of cooperative extension philosophy and methods and to prepare students for careers in extension and research or in related fields in public and commercial organizations. Topics relate to extension in other countries as well as in the United States.

650 Special Problems in Research and Teaching Fall, spring, or summer. 1 or more credits by arrangement with instructor. Undergraduates must attach to their course enrollment material written permission of the staff member who will supervise the work and assign the grade.
Staff.

716 Perspectives in Plant Breeding Strategies Spring. 2 credits. S-U grades optional. Prerequisite: Plant Breeding 603.
R 12:20–2:15. M. E. Sorrells.
Discussion of mating systems, selection techniques, and breeding strategies for self- and cross-pollinated

crops. Extensive outside reading is required. Emphasis is on the discussion and evaluation of selected benchmark papers and current literature.

717 Quantitative Aspects of Plant Breeding
Spring. 2 credits. Prerequisites: Plant Breeding 603 and Statistics 601. S-U grades only.
T R 10:10. R. L. Plaisted.
Discussion of random mating populations, inbreeding, and components of genetic variance.

718 Genetics and Breeding for Disease and Insect Resistance Fall, first 7 weeks of semester. 1 credit. Prerequisite: Plant Breeding 603. S-U grades only.
T R 10:10. V. E. Gracen.
Discussions of genetics and mechanisms of insect and disease resistance as they relate to the development and utilization of pest resistant varieties.

Plant Pathology

R. L. Millar, chairman; J. R. Aist, P. A. Arneson, S. V. Beer, C. W. Boothroyd, B. B. Brodie, R. S. Dickey, W. E. Fry, M. B. Harrison, R. K. Horst, G. W. Hudler, H. W. Israel, E. D. Jones, R. P. Korf, J. W. Lorbeer, W. F. Mai, W. F. Rochow, A. F. Sherf, W. A. Sinclair, R. W. Smiley, H. D. Thurston, H. D. VanEtten, R. E. Wilkinson, O. C. Yoder, M. Zaitlin, T. A. Zitter

Course Numbers

New	*Old*	*New*	*Old*
300	300	654	654
301	301	655	655
309	309	681	661
402	302	691	671
443	443	700	
497	431	701	501
498	431	703	503
499	431	705	505
504	404	706	506
641	656	707	507
642	657	708	508
645	645	709	579
646	646	715	
647	647	725	
648	648	726	556
649	649	728	
650	650	729	599
651	651	797	531
653	633	799	531

301 Introductory Plant Pathology Fall or spring. 4 credits. Limited to 100 students, 20 in each section; preference given to juniors, seniors and graduate students. Prerequisites: Biological Sciences 101–102, and 103–104 or 105–106. Plant Pathology 300 should be taken concurrently.
Lecs, T R 11:15; lab, M T W R or F 2–4:25, plus one unscheduled period weekly. W. A. Sinclair.
An opportunity to study fresh specimens of diseased field and forage crops, flowers, fruits and vegetables, trees and shrubs; to learn techniques of diagnosis such as isolation of pathogenic fungi and extraction of nematodes; to observe demonstrations and to perform exercises that display important phenomena or basic techniques in plant pathology.

309 Introductory Mycology Fall. 4 credits. Prerequisites: a year of botany or equivalent and permission of instructor.
Lecs, T R 1:25–2:15; labs, T R 2:30–4:25; and additional 2-hour period to be arranged. Required field trips. J. W. Lorbeer.
An introduction to fungi, emphasizing biology and comparative morphology rather than taxonomy.

402 Plant Disease Control Spring. 3 credits. Prerequisite: Plant Pathology 300–301 or equivalent.
Lecs, T R 11:15; lab and rec, T W or R 1:25–4:25. P. A. Arneson.
This course complements Plant Pathology 300–301 with an in-depth presentation of the principles and practices of plant disease control, building on the students' knowledge of diseases and their causal agents. General principles and concepts, illustrated by specific examples, are presented. Students write a term paper applying these principles to a specific disease control problem. The labs provide practical experience in diagnosis and disease control techniques.

443 Pathology and Entomology of Trees and Shrubs (also Entomology 443) Fall. 5 credits. Prerequisites: either Plant Pathology 301 and Entomology 292 or equivalent.
Lecs, M W F 10:10; labs, T R 1:25–4:25 or W F 1:25–4:25. W. T. Johnson, W. A. Sinclair.
For students preparing for careers in horticulture, urban forestry, and pest management. Deals with the nature, diagnosis, assessment, and treatment of diseases and arthropod pests of trees and shrubs. Forest, shade, and ornamental plants are considered.

497 Special Topics Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for independent study of a special topic in mycology or plant pathology under the direction of a faculty member.

498 Teaching Experience Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
Undergraduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor.

499 Undergraduate Research Fall or spring. 3–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for research experience under the direction of a faculty member.

504 Pest Management for Plant Protection (also Entomology 504) Fall. 4 credits. Limited to seniors and graduate students. Prerequisites: Biological Sciences 360 or equivalent and two of the following: Agronomy 315, Entomology 440, or Plant Pathology 402.
Lecs, M W F 8; lab, M or W 1:25–4:25.
P. A. Arneson.
Intended for practitioners in plant protection. Lectures integrate the principles of pest control, ecology, and economics in the management of pest-crop systems. A term project prepared by a team of four to five students is required and consists of a proposal for an extension pest management program on a specific crop. Labs deal with pest monitoring techniques and the application of computer simulation models to management problems.

Unless otherwise indicated the following description applies to courses 641–655.

Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Hours to be arranged.
Weekly discussions of current topics in special areas of plant pathology and mycology. Students are required to do extensive reading of current literature and to present oral and written reports.

641 Cytology of Plant Diseases
J. R. Aist, H. W. Israel.

642 Plant Disease Epidemiology
W. E. Fry.

645 Plant Virology
W. F. Rochow, M. Zaitlin.

646 Plant Nematology
M. B. Harrison, W. F. Mai.

647 Bacterial Plant Diseases
R. S. Dickey.

648 Pathogen and Disease Physiology
H. D. VanEtten.

649 Mycology
R. P. Korf.
Fall, Hemiascomycetes, Plectomycetes, Unitunicate Pyrenomycetes; spring, Bitunicate Pyrenomycetes.

650 Diseases of Vegetable Crops Fall.
J. W. Lorbeer, R. E. Wilkinson.

651 Diseases of Fruit Crops
Autotutorial slide and tape sets. P. A. Arneson.
For graduate students and advanced undergraduates with a particular interest in fruit. Covers the economic importance, causal agents, symptoms, disease cycle, and control measures for the major diseases of fruit in the Northeast.

653 Dendropathology
G. W. Hudler, W. A. Sinclair.

654 Diseases of Florist Crops
R. K. Horst.

655 Plant Diseases in Tropical Agricultural Development Spring.
H. D. Thurston.

681 Plant Pathology Seminar Fall or spring. 1 credit. Required of all plant pathology majors. S-U grades only.
T 4:30–5:30. Staff.

691 Plant Pathology Colloquium Fall or spring. 1 credit.
First and third R of each month, 8–10 p.m. Staff and graduate students.

700 The Science of Plant Pathology Fall. 1 credit. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: permission of instructor. S-U grades only.
Lec, R 9:05. R. L. Millar.
For students entering the graduate program. Consideration of plant pathology as a science, with emphasis on concepts, research, and philosophy.

701 Nature of Plant Disease Spring. 4 credits. Prerequisites: introductory plant pathology and permission of instructor.
Lecs, M W F 8; lab, W 1:25–4:25. W. E. Fry, O. C. Yoder.
The control of plant disease initiation and development at the molecular, organismal, and population levels of organization. Manipulation of factors important to disease development in populations is considered as the basis for disease management.

703 Diagnosis of Plant Disease Fall. 1 credit. Limited to graduate students with a major or minor in plant pathology. Prerequisite: Plant Pathology 701 or equivalent.
Lec, T 9:05 (Sept. 2–30 only); lab, T or R 1:25–4:25 (Sept. 2–30 only), 5 additional labs to be arranged. S. V. Beer and staff.
Provides instruction and practice in the diagnosis of plant diseases. All important classes of plant pathogenic agents are considered. Classical and modern techniques are discussed.

705 Plant Virology Fall. 1 credit. Primarily for graduate students with major or minor in plant pathology; others by permission. Prerequisite: permission of instructor.
Lecs, T R 11:15 (Oct. 2–30 only); lab, T or R 1:25–4:25 (Oct. 2–30 only). M. Zaitlin.
Basic information on plant viruses and on the diseases they cause. Emphasis on viral replication mechanisms.

706 Plant Nematology Spring. 2 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: permission of instructor.
Lec and 3-hour lab each week, hours to be arranged. W. F. Mai.
Anatomy, morphology, and taxonomy of plant parasitic forms and nonparasitic soil-inhibiting forms of nematodes are studied. Plant pathogenic forms are also considered from the standpoint of host-pathogen relationships, host ranges, life cycles, and the symptoms they cause. Principles and methods of control are discussed.

707 Bacterial Plant Pathogens Fall. 1 credit. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: permission of instructor.
Lec, T R 11:15 (Sept. 2–30 only); lab to be arranged. R. S. Dickey.
Basic information on bacterial plant diseases and phytopathogenic bacteria. The lab includes some of the more important techniques used in the study of bacterial plant pathogens.

708 Disease Physiology Spring. 1 credit. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: permission of instructor.
Hours to be arranged. Staff.
Basic information on the physiological basis for plant pathogenesis.

709 Advanced Mycology Spring. 4 credits. Prerequisites: Plant Pathology 309 or equivalent, a course in genetics, and permission of instructor. Offered alternate years.
Lec, M 10:10; labs, M W 1:25–4:25; an additional 3-hour period to be arranged. Optional field trips. R. P. Korf.
A detailed study of the biology and taxonomy of the major groups of plant pathogenic fungi (rusts, smuts, Fungi Imperfecti, Peronosporales), with emphasis on mechanisms of variation of fungi.

715 Applied Plant Virology Fall. 1 credit. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: permission of instructor.
Lecs, T R 11:15 (Nov. 4–Dec. 2 only); lab to be arranged. T. A. Zitter.
Applied aspects of plant virology including symptomatology, diagnosis, methods of virus transmission, and means of control.

[725 Advanced Plant Virology Spring. 2 credits. For graduate students with a major in plant pathology and special interest in plant virology. Prerequisite: permission of instructor. Offered alternate years. Not offered 1980–81. Hours to be arranged. M. Zaitlin.]

[726 Advanced Plant Nematology Fall. 2 credits. For graduate students with a major in plant pathology and special interest in nematology. Prerequisite: permission of instructor. Offered alternate years. Not offered 1980–81. Hours to be arranged. W. F. Mai.]

[728 Advanced Disease Physiology Fall. 2 credits. For graduate students with a major in plant pathology and special interest in disease physiology. Prerequisite: permission of instructor. Offered alternate years. Not offered 1980–81. Hours to be arranged. H. D. VanEtten.]

729 Taxonomy of Fungi Fall. 4 credits. Prerequisites: Plant Pathology 309 or equivalent, genetics, plant or animal taxonomy, and permission of instructor. Offered alternate years.
Lecs, M W 10:10; labs, M W 1:25–4:25; required field trips. R. P. Korf.
Emphasis is on the principles of taxonomy and nomenclature, critical evaluation of keys and monographs, and practice in identification. The Discomycetes are treated in detail.

797 Special Topics Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.
An opportunity for independent study of a special topic.

799 Graduate Research Fall or spring. 1–5 credits. S-U grades optional.
Hours to be arranged. Staff.

Pomology

W. J. Kender, chairman; G. D. Blanpied, L. L. Creasy, J. N. Cummins, F. W. Liu, G. H. Oberly, R. M. Pool, L. E. Powell, J. P. Tomkins

101 Tree Fruits Fall. 3 credits. Prerequisite: introductory biology (may be taken concurrently). Cannot be taken for credit after Pomology 104.
Lecs, T R 8; lab, M or W 2–4:25. G. H. Oberly.
A study of the general principles and practices of tree-fruit culture and their relation to the underlying sciences. Topics include propagation, varieties, orchard management, and growth and fruiting habits. Practical work is presented in grafting, pruning, site and soil selection, and planting.

104 Essentials of Fruit Growing Spring. 3 credits. Cannot be taken for credit after Pomology 101.
Lecs, T R 8; lab, T or W 2–4:25. J. P. Tomkins.
Growing tree fruits, grapes, small fruits, and nuts in the Northeast. The student who wants a course in commercial aspects of fruit production should take Pomology 101.

[208 Economic Fruits of the World Spring. 3 credits. Prerequisite: introductory biology, or permission of instructor. Offered alternate years. Not offered 1980–81.
Lecs, M W 10:10; lab, F 2–4:25. F. W. Liu.
The more important subtropical and tropical fruits such as citrus, banana, pineapple, mango, coffee, and cacao are considered. Morphology, physiology, and adaptation to climate are stressed rather than details of culture. A broad view of world pomology is given.]

[302 Fruit Tree Nursery Operation Spring, first 4½ weeks. 1 credit. Prerequisite: Pomology 101 or 104 or permission of instructor. S-U grades optional. Offered alternate years. Not offered 1980–81.
Lecs, M W 9:05; lab, M 2–4:25 J. N. Cummins.
This course is intended to familiarize the fruit producer with the operations and problems of the fruit tree nursery operator. Topics include production objectives, management decisions, and cultural aspects of nursery operation. Techniques of grafting, budding, pest identification, inspection, and grading of fruit tree planting stocks are included.]

304 Orchard Management I Spring. 3 credits. Prerequisite: Pomology 101 or 104.
Lecs, M W 8; lab, R 1:25–4:25. L. E. Powell.
A treatment of problems of concern to fruit growers such as site selection, planting and pruning systems, water relations, cold hardiness, dormancy, flowering, and fruiting. Physiological and practical aspects are emphasized.

305 Orchard Management II Fall. 3 credits. Prerequisite: Pomology 101 or 104. Recommended: Pomology 304.
Lecs, M W 8; lab, R 1:25–4:25. G. H. Oberly, L. L. Creasy.
A continuation of the principles of pomology presented in Pomology 304. Subjects include the later stages of fruit maturation, quality, harvesting, aspects of tree nutrition, protection from pests, and regulatory policies affecting fruit production and sale.

[306 Small Fruits Spring, last 9 weeks. 2 credits. Prerequisite: Pomology 101 or 104 or permission of instructor. Offered alternate years. Not offered 1980–81.
Lecs, M W 9:05; lab, M 2–4:25. J. P. Tomkins.
A study of the general principles and practices in the commercial culture of strawberries, brambles, blueberries, currants, gooseberries, elderberries, and cranberries.]

[307 Viticulture Fall. 3 credits. Prerequisite: Pomology 101 or 104 or permission of instructor. Offered alternate years. Not offered 1980–81.
Lecs, T R 9:05; lab, T 2–4:25. R. M. Pool.
Viticulture, with emphasis on the viticulture of the Great Lakes region, as a series of interrelated decisions on varieties, sites, vine management, and vine protection, is presented. Those decisions are based on ampelography, meteorology, soils, vine and grape anatomy and physiology, as well as protection of the vine and grapes from injuries, primarily diseases and insects.]

310 Postharvest Physiology and Storage of Fruits and Vegetables Fall. 3 credits. Prerequisite: a course in pomology or vegetable crops, or permission of instructor.
Lecs, M W 9:05; lab, F 2–4:25. One field trip is required. F. W. Liu.
The chemistry and physiology of fruits and vegetables as they affect quality and marketability are studied. Maturity indices, handling methods, and storage practices are considered. Practical work includes observations of the effect of handling and storage methods on quality and condition of fruits and vegetables.

311 Fruit Crop Systematics Fall, first 4½ weeks. 1 credit. Prerequisite: Pomology 101 or 104 or permission of instructor. S-U grades optional. Offered alternate years.
Lecs, T R 9:05; lab, T 2–4:25. G. H. Oberly.
The classification of fruit species is considered from a botanical and production viewpoint. The course deals with the identification and naming of fruit species and varieties and their botanical classification.

313 Utilization of Fruit Crops Fall, middle 4½ weeks. 1 credit. Prerequisite: Pomology 101 or 104 or permission of instructor. S-U grades optional. Offered alternate years.
Lecs, T R 9:05; lab, T 1:25–4:25. F. W. Liu.
A consideration of the fate after processing of fruits produced for consumption. The coverage of fruit products is generally limited to those commercially grown and processed in New York State. Although the discussion includes methods of canning, freezing, dehydration, and other types of processing, emphasis is on the quality requirement and proper handling of raw materials and how they affect the quality of end products.

315 Fruit Variety Improvement Fall, last 4½ weeks. 1 credit. Prerequisite: Pomology 101 or 104 or permission of instructor. S-U grades optional. Offered alternate years.
Lecs, T R 9:05; lab, T 2–4:25. Staff.
The techniques and limitations of producing new varieties of perennial fruit crops are considered.

400 Undergraduate Seminar Spring. 1 credit (may be taken twice for credit). Prerequisite: a course in pomology. S-U grades only.
Hours to be arranged. Staff.
Seminar topics and speakers selected and arranged by the students on subject areas related to pomology.

402 Special Topics in Experimental Pomology Spring. 3 credits. Open to undergraduates by permission. Offered alternate years.
Hours to be arranged. Staff.
Selected topics are considered with respect to the

current literature or experimental techniques. Topics reflect the research interests of the professors who participate.

[604 Growth and Development of Woody Plants Spring. 2 credits. Prerequisite: introductory plant physiology. Offered alternate years. Not offered 1980–81.
T R 9:05. L. E. Powell.
An advanced course dealing with physiological, morphological, and biochemical changes during development, beginning with the seed and advancing through the mature reproductive plant. Hormonal control mechanisms emphasized.]

610 Research Fall or spring. 2 or more credits. Prerequisite: a course in advanced pomology. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the staff member who will supervise the work and assign the grade.
Staff.

700 Graduate Seminar Fall. 1 credit. S-U grades only.
Hours to be arranged. Staff.
Reports by students on current research or literature in experimental pomology or related areas.

710 Teaching Experience Fall or spring. 1 credit. S-U grades only. Prerequisite: permission of instructor.
Hours to be arranged. Staff.
Designed to acquaint pomology graduate students with the methods and materials involved in teaching. The student participates in the design, delivery and evaluation of segments of a departmental course.

Related Course in Another Department

General Horticulture (Vegetable Crops 103)

Rural Sociology

E. C. Erickson, chairman; M. L. Barnett, F. H. Buttel, H. R. Capener, E. W. Coward, Jr., G. J. Cummings, P. R. Eberts, E. C. Erickson, J. D. Francis, P. Garrett, C. C. Geisler, J. C. Preston, B. M. Scott, F. W. Young

100 Introduction to Sociology Fall. 3 credits.
Lecs, T R 10:10; disc, M or F 9:05, 10:10, 11:15, 12:20, 1:25, or 2:30. C. C. Geisler and staff.
An examination of the theories, concepts, and methods of sociology as they apply to sociology in general. Major topics include the origins of the discipline, its major theoretical and methodological currents, and its application to contemporary questions of power and bureaucracy, social and cultural change, materialism and sociobiology, social class and community institutions. 100 is formally equivalent to 101 (offered in the spring), though less emphasis is placed on rural society and its problems.

101 Introduction to Rural Sociology Spring. 3 credits.
Lecs, T R 10:10; disc, M or F 9:05, 10:10, 11:15, 12:20, 1:25, or 2:30. F. H. Buttel and staff.
An examination of the theories, concepts, and methods of sociology as they apply to rural society, particularly in relation to major issues concerning the United States agricultural and food systems. Major topics include change in the structure of agriculture and in rural communities, inequality in rural America, the structure and functioning of agribusiness organizations, agricultural policy, energy and environmental problems, and alternative futures for rural development in the United States. 101, though placing greater emphasis on rural society, is equivalent to 100 (offered in the fall).

105 Rural Sociology and World Development Problems Fall. 3 credits.
M W F 10:10. P. Garrett.
An introduction to the analysis of some pressing social problems of contemporary Third World countries. Lectures and reading materials will present different approaches, analyses, and recommendations which follow from competing theories, in order that the student may determine which approach best explains the situation in Third World countries. Topics to be considered include: visions of "development"; the social organization of peasant communities and large-scale agricultural enterprises; problems of land tenure and agrarian reform; the relationships among population growth, hunger, and employment; multinational corporations; social movements and social control.

213 Social Indicators and Data Management Spring. 3 credits.
M W F 11:15. F. W. Young.
Introductory sociological research methods, from the perspective of social indicators, their construction, sources of data, and their policy relevance. The course also surveys currently reported social indicators for the United States. Students work through computer exercises illustrating basic data management using SPSS programs.

240 Social History of American Agriculture Spring. 3 credits. No prerequisites.
T R 8:30–9:55. E. C. Erickson and staff.
A social and technical history of the changes in agriculture and the agricultural systems in the United States from about 1800 to the present day. Includes documentation of the technologies associated with agriculture as well as the rural social organization that supported the agricultural system (such as farm organizations, marketing systems, export patterns, transportation systems). Emphasizes the energy systems that included animal and human power in the eighteenth and nineteenth century, horsepower in the latter nineteenth century, steam and mechanical power from the early twentieth century onwards, and the managerial emphasis of the recent years.

300 Proseminar: Issues and Problems in Rural Society Fall. 1 credit. S-U grades only.
R 12:20–1:25. Staff.
Introduces the student to subject matter of concern to both applied and academic rural sociologists. Focuses on such subjects as migrant workers, agribusiness, rural poverty, rural to urban migration, rural development, agricultural research and people, community development, small farmers in the lesser developed nations. These topics are explored through the use of films and group discussion.

324 Social Organization and the Environment Spring. 3 credits.
M W F 9:05. Staff.
A discussion of principles involved in our interaction with our physical environment, viewed from a human ecological and ecosystem perspective. Emphasis is given to the function of social organization in human-environment exchanges. Principles are illustrated by referring to both developing and developed societies. The course provides a conceptual framework for understanding and addressing recurring environmental issues.

355 Rural Development and Cultural Change (also Anthropology 314) Fall. 3 credits.
M W F 11:15. M. L. Barnett.
An analysis of planned social change programs in predominantly agricultural societies. Focusing on problems of administration, socioeconomic development, and the introduction of new practices.

356 Rural Society in America Fall. 3 credits. S-U grades optional.
M W F 9:05. Staff.
The focus is on gaining a greater understanding and appreciation of the rural sector of American society. From sociological and historical perspectives, the nature of changes in rural society are examined, including the impact of technology on agriculture, other extractive industries, natural resources, the environment, regional variation, the rural-urban dominance theme, comparative life styles, cultural orientations, value patterns, and a look to the future.

357 Subsistence Agriculture in Transition Spring. 3 credits.
Lecs, T R 10:10–11:25. M. L. Barnett.
An analysis of selected types of peasant communities, drawn from differing ecological conditions. Social structure, systems of farming and land tenure arrangements, and motivational characteristics of subsistence farmers in the context of socioeconomic change. Theoretical and policy aspects of modernization and traditional agriculture and programming for agricultural development.

380 Independent Honors Research in Social Science 1–6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.
Staff.
Students must submit written proposals, by the third week of the fall semester of their senior year, to P. Garrett, departmental honors committee representative.

404 Intermediate Sociological Theory (also Sociology 404) Fall. 4 credits. S-U grades optional.
T R 10:10–12:05. P. R. Eberts.
An advanced undergraduate seminar for senior majors in rural sociology and sociology. The course will focus on: (1) the central concepts of the sociological tradition; (2) major classical theorists (Marx, Weber, Durkheim, Tocqueville) and contemporary counterparts; (3) application of the classical ideas in contemporary research.

424 Science, Technology, and Social Change Fall. 3 credits.
T R 12:20–1:35. S. Del Sesto.
The effect of science and technology in the process of social change is examined. Different theories of social change are applied to specific issues in science and technology such as new energy systems, environmental pollution, the management of natural resources, genetic engineering and behavior control, and the relations between science and technology and alienation. The objective is to explain the movement of current events and to predict changes and outcomes in these issue areas.

[432 Community Development Fall. 3 credits. Not offered 1980–81.
T R 10:10–11:25. J. C. Preston.
Examines the major concepts, trends, and issues in community development from the perspective of the community development change agent. Areas examined include: community, community change, community action, community conflict, community leadership, citizen involvement, and strategies and tactics for planned community change.]

436 Small Towns Seminar Spring. 2 or 3 credits.
T 2:30–4:25. G. J. Cummings.
A review of selected approaches to understanding patterns of change in small population settlements. The concept of self-help along with other options for development are examined in terms of their potential contributions for enhancing the quality of community life.

[443 Politics and Development Fall. 3 credits. Limited to upperclass and graduate students. Prerequisite: Rural Sociology 100 or equivalent. S-U grades optional. Not offered 1980–81.
T R 10:10–11:25. P. R. Eberts.
Comparative analyses of politics as a significant process affecting societal development. The course examines politics and policies as major means of social control, resource redistribution, and stimuli for development in production, allocation, and

service-staffing processes; pluralism and inequalities among various socioeconomic classes, different-sized communities, and mutually interdependent institutions, as they affect social order and development.]

454 Rural Development Policy Analysis Spring. 3 credits.
R 2:30–4:25. J. C. Preston.
Focus on public policies and programs that relate to domestic rural development. Areas examined include a conceptual framework for rural development and policy analysis, public policy process, regional programs, grantsmanship in rural development, policy research, and projecting the future in regard to rural development policy.

462 Changing Health Perspectives Spring. 3 credits.
M W F 2:30. G. J. Cummings.
Major determinants of health status and their interrelationships are studied as a basis for evaluating various models that are proposed for improving the organization of health services for underserved populations. Readings are mainly drawn from the United States and Canadian experiences. Other cases can be considered according to student interests.

497 Informal Study Fall or spring. 1–3 credits (may be repeated for credit). S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade.
Staff.
Informal study may include a reading course, research experience, or public service experience.

606 Contemporary Sociological Theories of Development Fall. 3 credits.
M W F 11:15. F. W. Young.
A review of theory, empirical studies, and policy prescriptions as applied to communities and regions, especially those in less-developed countries. Human ecology, the Weberian tradition, central place, dependency, and symbolic structural theory are compared.

618 Research Design I Fall. 4 credits.
M W F 10:10; lab to be arranged. J. D. Francis.
First of a two-semester sequence (may be taken individually) in graduate methods. This course discusses problems of measurement, the design of measuring instruments, and problems of reliability and validity. Some common forms of measuring instruments are discussed, including multidimensional techniques. Students are expected to use actual data for labs.

619 Research Design II Spring. 4 credits.
Prerequisite: an introductory methods course or a statistics course.
M W F 10:10; lab to be arranged. J. D. Francis.
The second part of the sequence in graduate methods deals with sampling frames, some pragmatic sampling techniques, and some discussion of statistical analysis procedures appropriate under each. An intermediate-level treatment of the following topics: nonexperimental designs, regression analysis, analysis of variance, analysis of covariance, and causal models. A classic piece of sociological research is one source of illustration and a component of the lab exercises. Students are expected to use actual data to familiarize themselves with data handling and processing.

[621 Environmental Sociology Fall. 3 credits. Not offered 1980–81.
W 1:25–4:25. F. H. Buttel.
An exploration of various sociological approaches to the study of society and its physical environment and an analysis of major issues relating to the survival base of human societies — particularly overpopulation, the energy and food crises, the limits-to-growth debate, and the conduct of political struggles over energy and environmental policy.]

[641 Political Economy of Rural and Regional Development Spring. 3 credits. Limited to upperclass or graduate students. S-U grades optional. Not offered 1980–81.
T R 10:10–11:25. P. R. Eberts.
An interdisciplinary course focusing on social, political, and economic factors in regional development. Theories from demography, ecology, social organization, and planning are used to examine the emergence of new forms of social organization and their implications for contemporary societies.]

642 Macrosystems Theory and Policy Analysis Spring. 3 credits. S-U grades optional.
F 12:20–2:50; disc to be arranged. P. R. Eberts.
An analysis of major theoretical and research problems related to the application of systems theory to society's changing organizational process. Major theories are examined, with attention to their compatibility with modern analytic techniques such as simulations and projections in analyzing current issues in macropolitical economy.

[650 Social Organization of Agriculture Fall. 3 credits. Not offered 1980–81.
R 1:25–4:25. E. C. Erickson.
Concentrates on a small number of significant commercial crops, examining the institutions and relationships involved in the production process: research, credit, distribution of inputs, the farm operation, processing, transportation, and marketing. Patterns at the farm and community level, including topics such as settlement, land tenure, ethic groups, class structures, methods of cooperation, small farmers, labor problems, and information networks. Ecological and physical constraints on production. Emphasis on the influence of national and international structures — political, social, and economic — on the production process, including the role of government and quasi-government units. Examines the historical circumstances giving rise to the present crop systems. Consideration of what rearrangements of the political, social, and economic structures, both domestic and international, are required for change in crop systems, improvement in production, and increased social welfare.]

651 Structural Change in United States Agriculture Fall. 3 credits.
T 1:25–4:25. F. H. Buttel.
An analysis of the structural transformations of United States agriculture in the nineteenth and twentieth centuries, particularly in terms of the role of the state in agricultural development. This course emphasizes the historical roots of the socioeconomic problems of contemporary agriculture and examines the prospects for and limitations of various strategies for ameliorating these problems.

[706 State, Economy, and Society Spring. 3 credits. Not offered 1980–81.
Hours to be arranged. F. H. Buttel, C. C. Geisler, and P. Garrett.
Reviews major issues concerning the relations between political and economic institutions, including the political-economic methodologies of the classical sociological theorists, the instrumentalist-structuralist debate on the nature of the state, theories of crisis in advanced capitalism, and the controversies among theorists of unequal exchange, dependency, and imperialism in the world system.]

[712 Factor Analysis and Multidimensional Scaling Fall. 4 credits. Prerequisite: previous course work in scaling and statistics. Not offered 1980–81.
M W F 10:10; lab to be arranged. J. D. Francis.
Topics include philosophy of factor analysis, factor analysis models, factoring design, factoring techniques, and comparison with factor analysis models. Multidimensional scaling and discriminant analyses are also discussed. As matrix algebra is an integral part of these procedures, class time is devoted to this topic.]

715 Macrosocial Accounting and Evaluation Spring. 3 credits.
R 1:25–4. F. W. Young.
A new methodology for monitoring and evaluating rural development projects based on data from informants, field analysis with a microcomputer system, and a generalized evaluation design. The relationship of this method to conventional evaluation as well as to comparative subnational analysis of whole countries is reviewed.

[717 Regression and Path Analysis Spring. 4 credits. Prerequisite: 2 courses in statistics and 1 in methods. Not offered 1980–81.
M W F 10:10; lab to be arranged. J. D. Francis.
The first part of the course reviews multiple and nonlinear regression. Two-stage least squares models are discussed for sociological data along with a discussion of nonmetric regression. The latter half of the course deals with recursive and nonrecursive path models.]

723 Social Movements in Agrarian Society Spring. 3 credits.
T 1:25–4. F. W. Young.
The recent research explosion in this area is approached in terms of the several fundamental explanatory formats, a comparison of class-based and region-based movements, and research on the United States and the Third World.

741 Community Development and Local Control Spring. 3 credits.
Hours to be arranged. C. C. Geisler.
Theories of community growth and decline and the current debate over the place of local control in community development in general are considered. Salient themes include the role of neopopulism in community development, changing institutions of property as community development occurs, and changing definitions of "community."

751 Applications of Sociology to Development Programs Fall. 3 credits.
R 1:25–4:25. E. C. Erickson.
A consideration of problems of implementing change strategies at national, regional, and institutional levels, especially as they relate to rural development. Focus is also on institutional constraints on the sociologist as a researcher, as a strategist, and as a participant and on the different contexts within which developmental change occurs.

754 Sociotechnical Aspects of Irrigation Spring. 2–3 credits.
Hours to be arranged. M. L. Barnett, E. W. Coward, Jr., and G. Levine.
Examines irrigated agriculture and its relation to agricultural development. Emphasis on social processes within irrigation systems and interactions with the social setting. The seminar provides an opportunity to examine systematically the institutional and organizational policy issues associated with the design and operation of systems of irrigated agriculture.

771 Special Seminar Fall or spring. Credit to be arranged. Limited to graduate students; others by permission of instructor.

791 Teaching Experience Fall or spring. 1–3 credits. Limited to graduate students. S-U grades only.
Staff.
Participation in the ongoing teaching program of the department.

792 Public Service Experience Fall or spring. Credit to be arranged. Limited to graduate students. S-U grades optional.
Staff.
Participation in the ongoing public service activities of the department.

871–874 Informal Study Fall or spring. Credit to be arranged. Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional.

871 Rural Sociology

872 Development Sociology

873 Organization Behavior and Social Action

874 Methods of Sociological Research

881 Research Fall or spring. Credit to be arranged. Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional.

Statistics and Biometry

F. B. Cady, W. T. Federer, D. S. Robson, S. J. Schwager, S. R. Searle, D. L. Solomon

Courses in statistics and biometry are offered by the Department of Plant Breeding and Biometry.

200 Statistics and the World We Live In Spring. 3 credits.
Lecs, T R 10:10–11:25; disc, M 10:10 or 1:25 or T 9:05, 1:25, or 2:30. W. T. Federer.
Focus is on a better consumer understanding of statistical design, data collection, and information. Concepts of statistics, measurements and measuring instruments, data collection, principles of scientific investigation, survey design, questionnaire construction, experiment design, treatment design, graphs, tables, probability, averages, measures of variation, common distributions, confidence intervals, sample size, international and national statistics, and some simple statistical methodology are presented.

408 Theory of Probability Fall. 4 credits. Prerequisite: Mathematics 106, 108, or 112, or permission of instructor.
M W F 10:10; disc, M 3:35. Prelims, 7 p.m. Oct. 23 and Nov. 20. S. J. Schwager.
An introduction to probability theory: combinatorics, random variables and their probability distributions, generating functions, and limit theory. Biological and statistical applications are the focus. Can serve as either a terminal course in probability or as a foundation for a course in the theory of statistics.

409 Theory of Statistics Spring. 4 credits. Prerequisite: Statistics 408 or equivalent.
M W F 10:10; disc, M 3:35. S. J. Schwager.
The concepts developed in Statistics 408 are applied to provide an introduction to the classical theory of parametric statistical inference. Topics include data reduction and the concept of sufficiency, parameter estimation, hypothesis testing, and linear regression. Students seeking training in statistical methodology should consider Statistics 601–607.

416 Matrix Algebra I Fall. 2 credits. Prerequisite: precalculus mathematics.
Lecs, M W F 8; disc, M 1:25–2:15 (first 7 weeks). S. R. Searle.
Definitions, basic operations and arithmetic, determinants, and the inverse matrix. Emphasis is on understanding basic ideas.

417 Matrix Algebra II Fall. 2 credits. Prerequisite: Statistics 416 or permission of the instructor. No auditors.
Lecs, M W F 8; disc, M 1:25–2:15 (second 7 weeks). S. R. Searle.
Rank, linear dependence, canonical forms, linear equations, generalized inverses, characteristic roots and vectors. Emphasis is on developing skills for applying matrix algebra.

600 Statistics Seminar Fall or spring. 1 credit. S-U grades only.
W 3. Staff.

601 Statistical Methods I Fall. 4 credits. Limited to graduate students; others by permission of instructor.
Lecs, M W F 9:05 or 11:15; lab, M 12:20–1:50 (two sections), 2:30–4 (two sections), 7:30–9 or T 12:20–1:50 or 2:30–4 (two sections). When two sections meet simultaneously, one may be more mathematical than the other, depending on the availability and interest of students with a knowledge of calculus. Prelims, 7 p.m. Oct. 21 and Nov. 18. D. L. Solomon.
Statistical methods, both parametric and nonparametric, are developed and used to analyze data arising from a wide variety of applications. Topics include point and interval estimation, hypothesis testing, inference for a single population, comparisons between two populations, one- and two-way analysis of variance, comparisons among population means, analysis of categorical data, and correlation and regression analyses. Interactive computing is introduced through the MINITAB statistical computing system. Emphasis is on basic principles and criteria for selection of statistical techniques.

602 Statistical Methods II Spring. 4 credits. Prerequisite: Statistics 601 or equivalent.
Lecs, M W F 9:05 or 11:15; lab, M 12:20–2:15 or 2:30–4:25, or T 10:10–12:05, 12:20–2:15, or 2:30–4:25. F. B. Cady.
Continuation of Statistics 601. Emphasis on data analysis and inference for a wide variety of research situations using standard multiple regression programs. Topics include estimating and interpreting sequential and partial coefficients and sums of squares, prediction, residual plotting, model building, estimation of standard errors, analysis of sample means from one-way and multiway classifications, factorial experiments, estimation of contrasts, covariance analysis, comparison of regression lines, model (variable) selection with many predictor variables and principles of experimental design. Selected topics from pairwise comparisons among means, transformations of data, response surface methodology, weighted regression, random effects models, nonlinear regression, split plot experiments, combining experiments, and analysis of categorical data. MINITAB and SAS statistical computing packages are used.

[605 Applied Regression Analysis Fall. 1 credit. Prerequisite: Statistics 602. Not offered 1980–81.
A continuation of Statistics 602, with emphasis on data analysis using a regression or linear model approach. Comparison of variable selection procedures. Biased estimation. Variable selection for prediction. Regression approach to nonorthogonal analysis of variance situations. Case study for complex data set.]

606 Sampling Biological Populations Fall. 1 credit. Prerequisite: Statistics 601 or equivalent. Offered alternate years.
D. S. Robson.
Standard methods of sample survey design and estimation are presented, including stratified-random sampling, cluster sampling, double sampling, and variable probability sampling. Special emphasis given to methods of particular utility or specifically designed for biological sampling. Examples are taken from forestry, fisheries, and other biological areas.

[607 Nonparametric and Distribution-Free Statistical Methods Spring. 1 credit. Prerequisite: Statistics 601 or equivalent. Offered alternate years. Not offered 1980–81.
D. L. Solomon.
Nonparametric and distribution-free alternatives to normal-theory testing procedures are presented: randomization tests; location and scale tests for two populations; analyses for completely randomized, randomized blocks, and balanced incomplete blocks designs; comparisons among several means; correlation and regression; goodness-of-fit.]

662 Mathematical Ecology (also Biological Sciences 662) Spring. 3 credits. Prerequisites: a year of calculus, a course in statistics. Offered alternate years.
M W F 12:20. D. L. Solomon, S. A. Levin.
Mathematical and statistical analysis of populations and communities: theory and methods. Spatial and temporal pattern analysis, deterministic and stochastic models of population dynamics. Model formulation, parameter estimation, simulation, and analytical techniques.

699 Special Problems in Statistics and Biometry Fall, spring, or summer. 1 credit or more by arrangement with instructor.
Staff.

701 Advanced Biometry Spring. 3 credits. Prerequisites: Statistics 409 and 602.
T R 1:30–2:45. D. S. Robson.
Bioassay methods including parametric and nonparametric statistical analyses of quantal and graded response to controlled levels of single and multifactor stimuli; directional statistics as applied to animal orientation experiments; compartment models and analyses; enzyme kinetics and pharmacokinetic analysis; bioavailability.

[713 Experiment Design Fall. 4 credits. Prerequisites: Either Statistics 416 and 602 or equivalent. Offered alternate years. Not offered 1980–81.
T R 8–9:50; disc to be arranged. W. T. Federer.
Principles and techniques of experimentation, theoretical concepts, extensions and variations of the completely randomized, generalized blocked, and generalized row by column experiment designs, repeated measures designs, interval estimation for ranked means, transformations, unequal variances, additivity, residual analyses, sample size, variance component analyses, unequal number analyses, the place of orthogonality, balance and confounding in design, and advanced statistical methodology.]

714 Treatment Design and Related Experiment Designs Fall. 4 credits. Prerequisites: Statistics 416–417 and 602. Offered alternate years.
T R 8–9:50; disc to be arranged. W. T. Federer.
Treatment design, the selection of treatments for an experiment, is divided into factorial, response surfaces, mixtures, and combinations of these. Single degree of freedom contrast matrices, factorial design theory for prime powers and nonprime powers, confounding, split plot, split block, complex confounded designs, lattice designs derivable from pseudofactorial theory, fractional replication, response surface designs, and designs and analyses for mixtures, including diallel crossing designs, are covered. Statistical analyses involving residual analyses and real data are included. Emphasis is on concepts and applications rather than mathematical manipulations.

717 Linear Models Spring. 3 credits. Prerequisites: Statistics 409, 417, and 602 or Mathematics 472. S-U grades only. Offered alternate years.
S. R. Searle.
Introduction to multinormal variables and distribution of quadratic forms; linear statistical models, estimable

functions and testable hypotheses, regression models, experimental design models, and variance component models and combinations thereof.

[720 Statistical Design Theory Fall. 3 credits. Prerequisites: Mathematics 431–432 and a course in design theory. S-U grades only. Not offered 1980–81.
W. T. Federer.
Primarily for those doing research on statistical design topics. Areas discussed are generalizations of balanced and partially balanced block design theory, F-square and latin square geometries, variance and other optimality criteria, fractional replication, and other topics of interest to participants. Many unsolved statistical design problems are posed.]

799 Statistical Consulting Fall and spring. 2 credits. Limited to graduate students.
Consulting, 1 hour a week; disc, 1 hour a week; hours to be arranged. Staff.
Participation in the Biometrics Unit consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of selected consultations encountered by the service during the previous week.

890–990 Research Fall or spring. Credit to be arranged. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned. S-U grades only.
Research at the M.S. (890) or Ph.D. (990) level.

Vegetable Crops

R. D. Sweet, chairman; L. Ellerbrock, E. E. Ewing, J. R. Hicks, W. C. Kelly, P. M. Ludford, P. L. Minotti, H. M. Munger, M. A. Mutschler, R. F. Sandsted, L. D. Topoleski, D. H. Wallace, H. C. Wien.

103 General Horticulture Spring. 4 credits. Each lab limited to 25 students.
Lecs, M W F 8; lab, M T W R or F 2–4:25.
L. D. Topoleski.
Acquaints the student with applied and basic horticulture. Primarily for students who want a general knowledge of the subject or who want to specialize in horticulture but have a limited background in practical experience or training in plant science. Includes flower, fruit, and vegetable growing and gardening techniques.

123 Organic Gardening Spring. 2 credits. Each section limited to 20 students. Primarily for students not enrolled in the College of Agriculture and Life Sciences. Prerequisite: permission of instructor.
M T W or R 1:25–4:25. W. C. Kelly.
Students must be prepared to lead a discussion and write a paper on some aspect of home gardening or amateur horticulture. Organic methods of gardening are discussed and demonstrated, but other methods are not excluded from the discussions.

210 Vegetable Types and Identification Fall. 2 credits.
T 10:10–12:05 or 2–4. L. D. Topoleski.
Acquaints the student with the vegetable species grown in the Northeast and the pests and disorders encountered in their production. Subjects covered include identification of economically destructive weeds, diseases and insects of vegetables, identification of vegetable and weed seeds, seedlings, nutrient deficiencies, vegetable judging, grading, and grade defects.

211 Commercial Vegetable Crops Fall. 4 credits. Limited to 50 students. Prerequisites: Vegetable Crops 103 and Agronomy 200.
Lecs, M W F 11:15; lab, W or F 2–4:25; field trips (Sept.), W 11:15–6. E. E. Ewing.
Intended for those interested in the commercial vegetable industry from the viewpoint of production, processing, marketing, or the related service industries. Topics included are techniques, problems and trends in the culture, harvesting, and storage of the major vegetable crops, including potatoes.

312 Postharvest Handling and Marketing of Vegetables Fall. 3 credits.
Lecs, T R 9:05; lab, R 2–4:25; field trips in early fall.
J. R. Hicks.
Procedures used in marketing and shipping vegetables, including grade standards, methods of grading, packaging, harvesting methods, cooling principles, storage techniques, and market preparation.

401 Vegetable Crop Physiology Fall. 5 credits. Prerequisites: Vegetable Crops 211 and Biological Sciences 242 or equivalents.
Lecs, M W F 11:15; lab, M 2–4:25; disc, R or F 1, 2, or 3. W. C. Kelly.
Subjects include mineral nutrition as influenced by fertilization programs and crop sequence; nutrient interactions and induced deficiencies; growth and development; flowering; fruit setting; growth correlation; senescence; sex expression; photoperiodism; vernalization; and environmental factors affecting growth.

413 Kinds and Varieties of Vegetables Fall. 3 credits. Prerequisite: Vegetable Crops 211 or permission of instructor. Offered alternate years.
Lab, W F 2–4:25; day-long field trips September 13 and 20. H. C. Wien.
Designed to help students achieve proficiency in the evaluation of vegetable varieties through study of their origins, characteristics, adaptation, and usage. An important part of the course is the study of crops in the field. The vegetable seed industry is also discussed.

421 Plant-Plant Interactions Spring. 3 credits. Prerequisites: Agronomy 200 and any crop production course. Recommended: Biological Sciences 242.
Lecs, M W 8; disc, F 8. P. L. Minotti.
The manner in which plants affect the growth of other plants is examined with emphasis on crop situations rather than natural plant communities. Interactions in monoculture are considered as well as crop-associate crop interactions and weed-crop interactions. Fridays are devoted to a discussion and demonstration of weed control methods and production widely used in vegetable crops.

499 Undergraduate Research Fall or spring. 1 or more credits, by arrangement. Written permission from staff member directing the work must be obtained before course enrollment.
Hours to be arranged. Staff.
Special problems may be elected in any line of vegetable work.

601 Seminar Fall or spring. 1 credit. Required of graduate students majoring or minoring in vegetable crops. Limited to graduate students. S-U grades only.
R 4:30. Staff.

610 Special Topics in Vegetable Crops Fall or spring. 1 or more credits.
Hours to be arranged. Staff.

[612 Postharvest Physiology of Horticultural Crops Spring. 2 credits. Prerequisite: permission of instructor. Offered alternate years. Not offered 1980–81.
T R 8. P. M. Ludford.
Physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticultural plant parts. Topics include morphological and compositional changes in ripening and during storage life, some physiological disorders, aspects of hormone action and interaction, and a consideration of control.]

620 Teaching Experience Fall or spring. 1 or more credits by arrangement with instructor.
Hours to be arranged. Staff.
Participation in the teaching program of the department.

630 Research Methods in Applied Plant Science Spring. 3 credits. Prerequisite: permission of instructor. Offered alternate years.
T R 9:05–11. W. C. Kelly.
The planning of applied research programs. The advantages and limitations of conventional experimental designs as they apply to specific research problems. Discussions include a critical interpretation of experimental results from the literature.

801 Master's Thesis Research Fall or spring. Credit to be arranged.
Hours to be arranged. Staff.

901 Doctoral Thesis Research Fall or spring. Credit to be arranged.
Hours to be arranged. Staff.

Related Course in Another Department

Special Topics in Plant Science Extension (Plant Breeding 629)